CALIFORNIA SEWAGE WORKS JOURNAL

Official Publication of the California Sewage Works Association

An inspection of the L. A. County Sanitation Districts' treatment plant was part of the program for the 1942 fall meeting. Here, left to right, are: A. T. Wintersgill, W. M. Knapton, D. R. Kennedy, J. A. Harmon, E. A. Reinke, F. D. Bowlus, J. L. McBride, Jack Kimball.

Vol. XV 1943 No. 1

Minutes of

Fifteenth Annual Fall Convention

Los Angeles, California

September 20, 21, 22, 1942

Acknowledgment

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CALIFORNIA SEWAGE WORKS JOURNAL

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California Sewage Works Association

Tentative Program of the

16th Annual Meeting — A War Conference

FRESNO, CALIFORNIA

June 10, 11, 12 and 13, 1943

Headquarters—To be Announced

Thursday, June 10, 1943

8:00 P.M.—Informal smoker and "get-together."

Friday, June 11, 1943

8:00 A.M.—Registration—Hotel lobby.

10:00 A.M.—Opening of War Conference, by Carl M. Hoskinson, President.

How to Operate the Plant— William A. Allen, presiding.

Instruction in principles and application of certain of the processes in sewage treatment.

Each formal presentation of 25 minutes will be followed by a 20-minute discussion period.

10:10 A.M.—1. Sedimentation (separate)—Professor Henry J. Miles, Assistant Professor of Sanitary Engineering, University of Southern California.

11:00 A.M.—2. Sludge Digestion (separate)—Harold May, Engineer, Water and Sewage Division, City of Palo Alto.

2:00 P.M.—3. Combined Sedimentation and Digestion—Leon B. Reynolds, Professor of Sanitary Engineering, Stanford University.

2:45 P.M.—4. Trickling Filters—Frank S. Currie, Consulting Engineer.

3:30 P.M.—5. Chlorination—Wm. J. O'Connell, Consultant.

4:15 P.M.—6. Sludge Disposal.

5:00 P.M.—Adjournment.

8:00 P.M.—Queston and Answer Night—William A. Allen, presiding.
Bring along an idea and a problem to this very informal conference and trade them for new ideas to take back to your plant through exchange with other operators, equipment men, chemists, and engineers. Free discussion will be encouraged but will be controlled through Mr. Allen as Moderator.

Saturday, June 12, 1943

7:00 A.M.—Governing Board Breakfast Meeting.

9:00 A.M.—**How to Care for the Plant**— F. Wayland Jones, presiding.

Instruction on selected subjects connected with operation.

1. Pumps; 2. Sludge and Scum Removal Equipment; 3. Digester Heating and Mixing Equipment; 4. Sewage Flow Meters and Registering Devices; 5. Paints and Painting; 6. Motors and Electrical Equipment; 7. Lubrication; 8. Operation and Maintenance of Sewers.

2:00 P.M.— **How is the Plant Working?**—Dr. Richard D. Pomeroy, Consulting Chemist. A detailed analysis and presentation of procedure best calculated to determine effectiveness and efficiency of the plant.

1. Records; 2. Tests Required; 3. Demonstrations of Tests; 4. Interpretation.

(Continued on Page 96)

California Sewage Works Journal

Published by CALIFORNIA SEWAGE WORKS ASSOCIATION

The California Sewage Works Association is not responsible, as a body, for the supposed facts and opinions advanced in any of the papers, discussions or articles published in this Journal. Discussion of all papers is invited.

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Ordnance Dept., Fort Sill, Oklahoma

DERBY, Major Ray L.
Coast Artillery, Fort Winfield Scott, Calif.

DEWANTE, Lt. Randolph H.
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JORGENSEN, Lt. Homer W.
Sanitary Corps, Camp Robinson, Ark.

LUEBBERS, Captain Ralph H.
Sanitary Corps, Camp San Luis Obispo, Calif.

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Quartermaster Corps, Gardner Field, Calif.

MITTELSTAEDT, Brig. Gen. R. E.
Commander of the 79th Brigade

REIDELL, Lt. A. G.
Sanitary Corps

RIBAL, Major Raymond R.
Balloon Barrage Unit

SHELTON, Lt. M. J.

STOWELL, Lt. E. Ralph
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S-14 NTS., Harvard University

PRATT, Ensign Jack W.
Civil Engineer Corps, Overseas

YODER, Ensign M. Carleton
Engineering Officer

•

WITH THE U. S. PUBLIC HEALTH SERVICE

ARNOLD, G. E. Sanitary Engineer, 9th. Reg. O.C.D., San Francisco

CHANLETT, Emil T. Asst. San. Engr. (R), Indust. Hyg. Serv. Portland

DeMARTINI, Frank E.
P. A. San. Engr. State Rel. Div.,Washington, D.C.

HOMMON, H. B. San. Engr. Dir., Dist. 5, San Francisco

INGRAM, William T.
P. A. San. Engr., 9th Reg. O.C.D., San Francisco

LUDWIG, Harvey F.
Asst. San. Engr., Office for Malaria Control in War Areas, Atlanta, Georgia

NASI, Kaarle W. Asst. San. Eng., Plague Sup. Lab., San Francisco

ROBERTS, F. C. P. A. San. Engr., Kansas City, Mo.

•

IN SERVICE — BRANCH AND RANK UNKNOWN

BEST, G. R.
TOWERS, C. L.
BENAS, Benj.

NEW MEMBERS FOR 1943

Name	Connection
Adolphe, Robert C.	Assoc. San. Eng., U.S. Eng. Dept., Salt Lake City.
Besselievre, E. B.	The Dorr Co., Inc., Los Angeles.
Borland, Victor J.	Chief Draftsman, L. A. Co. Sanitation Dists.
Bush, A. F.	Asst. San. Eng., Camp Cook, Santa Maria, Cal.
Caldwell, David H.	Asst. San. Eng., State Bureau of Sanitary Engineering.
Cardillo, William V.	Sanitary Inspector, State Health Department.
Flannery, H. J.	City Engineer, City of San Jose.
Hammond, Robert H.	Asst. Engineer, U.S. Eng. Dept., Los Angeles.
Keller, James H.	Chief Chemist and Bacteriologist, Water and Sewage Plants, Basic Magnesium, Inc., Las Vegas, Nevada.
Lederer, K.	Director, Mercury Technical Cloth & Felt Corp., New York.
Lemon, Paul R.	Asst. Supt., Sewage Plant, California State Prison at Folsom.
Lowe, Robert P.	San. Eng., War Relocation Authority, Berkeley.
Maldonado, Ardis	Sales Engr., Pacific Clay Products, Los Angeles.
McLaren, Alfred M.	Sales Engr., Fairbanks-Morse Co., Los Angeles.
McRice, Donald J.	Asst. San. Engineer, Mather Field, Sacramento.
Miles, Henry J.	Assoc. Prof., Civil Eng., Univ. of So. California.
Peightal, Wm. H.	Chief Operator, Sewage Plant, U.S.N.R. Air Base, Los Alamitos.
Pisano, Frank	Chief Opr., Sewage Plant, City of Santa Clara
Roberts, F. C.	P. A. San. Eng., U.S. Public Health Service, Kansas City.
Robinson, W. S.	Chief Operator, Mojave, Calif.
Snyder, John A.	Jr. Opr., Sewage Plant, Hammer Field, Fresno.
Teel, Jess W.	Opr., Sewage Plant, Stockton Field, Stockton.
Todd, J. L.	Field Engr., Sanitation Div., L. A. Chemical Co.
Wright, L. R.	Supt. L. A. Co. Sanitation Dists. Sewage Plant.

MEMBERS DECEASED

The Secretary has been notified of the death of the following members:

W. L. Popp—Former City Engineer for the City of San Jose. Mr. H. J. Flannery has been appointed City Engineer.

A. D. Wilder—Former Director, Department of Public Works for the City and County of San Francisco. Mr. H. C. Vensano has been appointed Director.

FIFTEENTH ANNUAL FALL CONVENTION CALIFORNIA SEWAGE WORKS ASSOCIATION

Los Angeles, California

September 20, 21, 22, 1942

MINUTES OF THE MEETING

Sunday, September 20

President Fred D. Bowlus called the Convention to order at 8:20 P.M. in the Victory Room of the Clark Hotel with 27 members present. After making several announcements he explained the purpose of the meeting was to give the members an opportunity to discuss their operating experiences and problems on the subjects of sludge gas meters, sludge heating coils, digester scum, trickling filter distributors. For the next hour practically all the members present entered into a very interesting and informative discussion on these subjects. All the remarks and suggestions were recorded by stenotype and will be printed in the Journal.

Mr. Harold K. Palmer then reviewed the tentative standard specifications for sewage pumps, motors and controls as prepared by his committee which was recently appointed for this purpose. Considerable discussion, questions and suggestions were offered by the members as Mr. Palmer read each part of the specifications. The meeting was adjourned at 10:00 P.M.

Monday, September 21

With 114 members present, President Bowlus opened the meeting at 9:15 A.M. The first paper on the program, "Shore Pollution Reduction at San Francisco," by Charles Gilman Hyde, Consulting Sanitary Engineer, Department of Public Health, San Francisco, was read by Mr. A. M. Rawn. Mr. Rawn had been requested by Mr. Hyde to read his paper, as it was impossible for him to be present. The next paper was presented by Mr. J. L. McBride, City Engineer of Santa Ana, entitled "Orange County Joint Outfall and Sewage Treatment Plant," in which he reviewed the long standing problems peculiar to this 22-mile long outfall. Plans for the elimination of citrus by-product wastes from this joint outfall were explained by Mr. E. P. Hapgood, City Engineer of Anaheim, in his paper "Joint Land Disposal of Wastes from Three Citrus By-Products Plants." The Orange County Joint Outfall has also been burdened by cannery wastes from the City of Fullerton where attempts have been made to eliminate as much of the waste from the sewer as possible. Mr. Grover L. Walters, Superintendent of Water and Sewer Departments of this city, described the progress that had been made during the 1942 season in his paper, "Problems in Disposal of Peach and Tomato Wastes from the Largest Cannery in the West." The meeting was adjourned at 11:30 A.M.

Caravan—A caravan of 25 cars assembled at 12:00 noon on Sixth Street, just across the Los Angeles River Bridge, and proceeded to Long Beach, where the Bixby Pumping Plant was inspected. This plant, constructed in 1942 to serve the new Navy Hospital and residential area, was

of special interest because it does not have a wet wall. Two variable-speed pumps with capacities from 200 to 1400 gpm each lift the sewage directly out of the 18-in. influent line into a 2300-ft. force main.

The Pacific Coast Club was the next stop where the forty members of the Caravan were guests of the Long Beach Section of the American Association of Engineers at an excellent lunch. Mr. Herbert Davis of the Section welcomed the members of our Association and presented their host, Mr. D. R. Kennedy, superintendent of the Pipe Lines Division for the City of Long Beach. Mr. Kennedy introduced their members and then asked President Bowlus to introduce the members of the Sewage Works Association.

After lunch the Caravan proceeded to the Los Angeles City Terminal Island Treatment Plant and then to the Los Angeles County Sanitation District's Sewage Treatment Plant. At the latter plant the recent developments in preheating and seeding of raw sludge were observed and the new digestion units under construction were inspected. Each digestion unit was composed of three abandoned activated sludge tanks, each 12½x12½ feet in section and 175 feet long, two of which were covered by a fixed wooden roof. The last stop of the Caravan was at the new Los Angeles City Sewer Ventilation Plant.

Annual Banquet— Sixty-six members and guests attended the annual banquet which was held in the Victory Room of the Hotel Clark. After welcoming all those present, President Bowlus introduced the officers and their wives and then asked the following charter members to stand: E. A. Reinke, Wm. A. Allen, J. L. McBride, A. H. Koebig, J. C. Albers and R. F. Goudey. The speaker of the evening, Elmer Belt, M.D., president of California State Board of Public Health, was then introduced. Dr. Belt presented a very enlightening address supported by lantern slides on the subject, "The California State Board of Public Health; Its Service to the People of Our State."

Tuesday, September 22

Joint Breakfast With Public Works Officers—There were 25 present at the joint breakfast with the members of the Public Works Officers Department. In the absence of Mr. Clayton W. Paige, president of this department, who is now in military service, Mr. J. A. Manchini acted as chairman and, after introducing the various members, presented the guest speaker, Mr. Jack Finch of the Premier Oil & Lead Works of Los Angeles. Mr. Finch gave an exceptionally interesting talk, illustrated with colored slides, on the latest developments in the art of camouflage.

Joint Meeting With Public Works Officers— President Bowlus presided over the joint meeting with the Public Works Officers Department of the League of California Cities. The meeting was called to order at 9:15 A.M., with 76 members present. The first paper, "Ventilation of Large Sewers by City of Los Angeles," was presented by H. G. Smith, Engineer of Sewer Design and Plant Operation for that city.

A very timely and instructive discussion was opened by Captain William T. Ingram, Assistant Sanitary Engineer, U. S. Public Health Service, Office of Civilian Defense, Ninth Region, on the subject "Protection of Sew-

age Works in War Time." Captain Ingram briefly summarized a plan for the operation of sewage works under war conditions both before and after damage occurs. Damage by sabotage or enemy action should be anticipated and Captain Ingram referred to sixteen wartime precautions for operators of sewage works suggested by Major G. E. Arnold, sanitary engineer for the Ninth Regional U. S. Office of Civilian Defense, in a two-page mimeographed bulletin distributed to all members attending the convention. Serious thought should be given to the evaluation of the use of each part of the system by critical industries. The extent of possible damage by bombs and the effect of overloading of the sewerage system should be considered. Auxiliary operators should be trained and made familiar with the sewage works. Those in charge of supervision should be in complete cooperation and coordination with other departments and with their local civilian defense council.

After damage occurs, the questions of when to make repairs, extent of the health hazard, how and when to notify the water and health departments are of utmost importance. The possibility of danger from the effects of decontamination after a gas attack should be determined. The sewage works laboratory should be inventoried for the types of tests that could be utilized for other uses such as water testing. Community sanitation should be considered with the possibility of providing emergency privies in those areas where there is a minimum of open land as in apartment house districts. Mutual aid should be in effect not only between sewage works but with water works as well, keeping in mind the possibility of interchanging material and the use by the water department of the sewage plant chlorinators. Financial agreements should be arranged so that material, equipment, and labor can be quickly replaced or compensated for.

Captain Ingram called on the following public officials for their comments on this subject and a brief review of what their departments were doing or planning in the way of sewage works protection: D. R. Kennedy, of Long Beach; Mr. A. M. Rawn, of the Los Angeles County Sanitation Districts; Mr. H. P. Cortelyou, of Los Angeles; Mr. Walter N. Frickstad, of Oakland; Mr. Frank Rossi, of Modesto; Mr. Carl M. Hoskinson, of Sacramento; Mr. John A. Mancini, of Hayward; Mr. Harold L. May, of Palo Alto; Mr. R. D. Woodward, of Laguna Beach; Mr. R. F. Goudey, of Los Angeles; and Mr. Clyde C. Kennedy. The comments by these men indicated that considerable thought has already been given to the protection of the sewerage system from sabotage. The problem of sealing manhole covers was of particular concern as well as the protection of sewage plants from saboteurs. It was pointed out that anything and everything could be expected in the sewer. Of particular danger would be casing head gasoline which can penetrate through porous ground and even through brick manholes to enter the sewer. The inevitable loss of personnel will necessitate the training of additional help. The use of women should be considered for many of the jobs now done by men. Another point brought out was the importance of distinguishing between a health and a non-health hazard in connection with industrial wastes. At times of emergency the industrial wastes could be discharged into the storm sewers. In any case, the sewage

plant operator should know what degree of treatment is necessary to meet health requirements.

Major G. E. Arnold ended the discussion on protection of sewage works during war times by emphasizing the following points: need for auxiliary power; prevention of flooding; complete maps; incident drills; gas masks. He pointed out that in case of a gas attack the gas pollution of sewage would be very dangerous. Vital points of the sewage plant should be protected by revetments made of sacks filled with mixed earth and asphalt. The sealing of vital manhole covers was of great importance especially over power vaults. Major Arnold concluded by sketching on the blackboard a detail of one method of sealing covers by bolting down with bolts having a five-sided head which was recessed in the cover and seat so that a special wrench is necessary to remove the bolts.

The entire discussion was taken down by stenotype and will be printed in the next issue of the Journal.

The first paper of the afternoon session, "San Bernardino Sewage Treatment Plant Revisions," prepared by David H. Currie, engineer, Currie Engineering Company, was read by Mr. Hosgood, assistant superintendent, Water & Sewer Department, San Bernardino.

The meeting was opened for business at 2:00 P.M., and President Bowlus introduced Mr. E. B. Besselievre, engineer for the Dorr Company, Inc., who has recently been transferred to the West Coast from New York. Mr. Besselievre had been requested by Mr. A. M. Kivari, chairman of the nominating committee, who was not able to attend the convention, to present the following report:

> "The Nomination Committee recommends the following candidates for the various offices for the year 1943:
>
> President—Carl M. Hoskinson, Sacramento
> First Vice-President—Richard D. Pomeroy, Pasadena
> Second Vice-President—Frank S. Currie, San Bernardino
> Secretary-Treasurer—Jack H. Kimball, Santa Ana
> Director (1947)—Willis T. Knowlton, Los Angeles
>
> Respectfully submitted,
>
> Nominating Committee:
> A. M. Kivari, *Chairman*
> John F. Skinner
> Uno H. Erickson."

Mr. C. C. Kennedy moved that the report of the Nominating Committee be accepted, that nominations be closed and that the President cast a unanimous ballot for all the candidates. The motion was seconded by Mr. Arthur G. Pickett, and so ordered.

President Bowlus announced the resignation of Mr. Carl F. Tennant from the Association and explained that Mr. Tennant had served only four of his five-year term as Director of our Association. He then called for nominations for a Director to fill the one-year unexpired term. Mr. Wm. A. Allen nominated Mr. Jack C. Albers of Glendale. Mr. Reinke moved the nominations be closed. So ordered.

Committee reports were then called for. Mr. Arthur G. Pickett re-

viewed the work of the Membership Committee. The Publicity Committee was represented by a telegram from Chairman F. Wayland Jones, who sent regrets that he was not able to attend and promised a report of his committee's activities by mail. President Bowlus then reviewed the financing and publishing of Volume XIV of the Journal. Carl M. Hoskinson read his report on the Legislative Committee, and the Secretary reviewed the work of the Committee on Schools and Certification in the absence of the chairman, Kenneth W. Brown. A very complete report by the Pump and Motor Standards Committee was briefly reviewed by the chairman, Mr. Harold K. Palmer. Mr. Richard D. Pomeroy reported that the Design Practice Committee had not functioned this year due to the present conditions and suggested that the committee be abandoned until after the duration. A report on the Industrial Waste Committee was read by Mr. W. T. Knowlton. The Secretary-Treasurer's report was then presented and a brief review of the sources of income and the operating cost per member was given. Based on 243 active members, the operating expenses were $1.08 per member as against an income of $1.23. During the year, however, capital additions in the form of a four-drawer letter filing cabinet and a two-drawer card index file were purchased amounting to an additional cost of $0.19 per member, making a total expenditure of $1.27 per member and causing a deficit of $0.04 per member for the year 1942.

Under new business, Mr. Richard D. Pomeroy moved that there be only one meeting of the Association during the next year. Mr. Knowlton seconded the motion. Mr. Homer Jorgensen suggested that one meeting be held in the North and one in the South in order to reduce traveling. Mr. Wm. J. O'Connell was not in favor of splitting the state into two groups. Mr. Ed A. Reinke suggested that there should be more meetings than two a year if comparisons were made to activities in England. Mr. J. C. Albers was in favor of meeting at the same time as the League of California Cities. Mr. Besselievre stated that the New York Sewage Works Association meets jointly with the American Society of Civil Engineers for its annual meeting but that local sections meet several times a year and have programs designed for the operator. Mr. Wm. T. Ingram warned against complications resulting from requirements of our constitution in regard to meetings and elections. He was also of the opinion that if the one meeting was held in conjunction with the League meeting, many operators would not be able to attend. This would be alright if local section meetings were organized. Mr. Koebig believed more operators would attend if meetings were held with the League. Mr. Ramseier stated that the spring meetings had always been superior to the fall meetings and suggested that the attendance facts be obtained. Mr. Wm. A. Allen was of the same opinion and suggested that the members be contacted for their expression. Mr. Jorgensen stated that after listening to the arguments pro and con he was still of the opinion that it would be best to have meetings in the North and South because of less cost and transportation. Mr. Harold F. Gray stated that one of the duties of the Governing Board was to pick the time and place of the meetings and it should therefore not shift its responsibility on to the membership represented at this meeting. Mr. Gray moved that the motion before the meeting be tabled. Seconded and so ordered.

Before turning over the meeting to the newly elected president, Mr. Carl M. Hoskinson, President Bowlus expressed his appreciation to the membership for their cooperation throughout the year and then extended his best wishes to Mr. Hoskinson.

President Hoskinson announced that the Governing Board at its meeting on Monday had authorized the President to appoint a committee called the "Emergency Sewerage Protection Committee" with power to act. The aim of this committee was to obtain information and prepare plans for the self-protection and mutual aid of sewerage works in California. This committee would function for the Association but would offer its findings to the Sub-committee on Water Supply, Committee on Transportation, Housing, Works and Facilities, California State Council of Defense. Prof. Charles Gilman Hyde was tentatively appointed honorary chairman of this committee which was divided into a northern and southern group headed by Mr. Harold F. Gray and C. R. Compton respectively, as vice-chairman of each group. Members of the northern group were John J. Casey, Walter N. Frickstad, E. A. Reinke, Wm. T. Ingram, and W. W. White. Members appointed to the southern group were Wm. A. Allen, R. F. Goudey, R. D. Phelps, H. P. Cortelyou, and R. T. Gardner.

Mr. W. T. Knowlton moved that a rising vote of thanks and appreciation be given to the retiring president, Mr. Fred D. Bowlus. So ordered—in a big way.

President Hoskinson announced that the Federation of Sewage Works Associations was having its Third Annual Convention at Cleveland on October 22 to 24, 1943, and that Mr. Wm. A. Allen, our representative on the Federation Board of Control, was planning to attend. Mr. Ramseier requested that Mr. Allen find out whether or not the Federation is planning to publish monthly Journals as originally promised and why they had not published some very excellent papers which had recently been presented before the California Sewage Works meetings. Mr. Ramseier referred to two papers, one presented by Harvey F. Ludwig and Russell G. Ludwig entitled "Laboratory Flocculation of East Bay Sewage and the Mechanism of Flocculation in Water Purification and Sewage Treatment Practice" and the other "Detection of Metallic and War Gas Poisons in Sewage," by R. F. Goudey. The papers were never published in the Sewage Works Journal and in his opinion they should have been. Mr. Harvey F. Ludwig added that in his opinion the critical review of literature as published in the March, 1942 issue of the Sewage Works Journal was not critical, as it did not include any articles published in the California Sewage Works Journal. Mr. Richard D. Pomeroy suggested that perhaps our Association should not publish these papers which would be published in the Sewage Works Journal, but could print an abstract of them. Mr. Wm. T. Ingram stated there had been a long-standing difference of opinion on the matter of prior printing rights, and because the editor of the Sewage Works Journal has not been able to advise authors or the editor of our Journal if and when papers will be published it has been the policy of this Association to print all papers in our Journal.

Mr. Allen stated that he would convey the thoughts of the members to the Federation at the coming meeting in Cleveland.

The meeting was adjourned at 3:22 P.M.

Respectfully submitted,

JACK H. KIMBALL, *Secretary-Treasurer.*

Approved by C. M. HOSKINSON
January 2, 1943

REPORT OF MEMBERSHIP COMMITTEE

The Membership Committee regrets that there has been a reduction of 47 in the number of active members of the Association since December 31, 1941. Apparently this is due to the fact that many members have left their jobs to join the armed forces and also because the annual membership dues were raised this year from $2.00 to $4.00.

In spite of these handicaps, 22 new members were obtained, largely because of the efforts of individual members of the Committee. We also tried an experiment which apparently met with some success and should be extended by the Committee which carries on during the coming year.

We first obtained the attached list of sixty-odd cities in the State having a population of ten thousand, or more, and addressed the attached form letter to the mayor and city council of representative cities on this list. Briefly, this letter points out the advantage of membership in the Association and recommends that the city pay the membership dues of one or more interested city officials or employee and that they send at least one representative to the Association meetings.

Our success with this experiment indicates that similar letters should be sent early next year to the mayor and city council of all cities on the list and to the county boards of supervisors as well.

The following statistical data, relative to the membership of the Association, has been furnished us by the Secretary, Mr. Jack H. Kimball, to whom we are deeply indebted for the prompt and cheerful assistance which he gave us during the year.

Membership Renewals—	
Full subscription at $4.00	191
Half subscription at $2.50	29
New members—	
Full subscription at $4.00	20
Half subscription at $2.50	1
Reinstatements—	
Full subscription at $4.00	2
Total active members	243
Subscribers to C. S. W. A. Journal	6

In contrast to the above figures of the present year, on December 31, 1941, we had a total of 290 active members.

I would like to take this opportunity to thank Messrs H. W. Jorgensen,

A. M. Kivari, A. B. Shearer, E. R. Waggoner and George F. Wilkins for the service which they rendered on the Committee.

Respectfully submitted,

ARTHUR PICKETT, *Chairman*

FORM LETTER

(Sent by Membership Committee to Officials of Representative Cities)

Honorable Mayor and City Council,

...., California.

Gentlemen:

You are interested, I know, in all matters pertaining to the public health and sanitation of your community. Particularly, problems which affect the cost of sewage and garbage disposal and methods by which this service can most efficiently and economically be provided are of utmost importance to you.

In the administration of the affairs of your community you have undoubtedly appointed a committee to supervise and direct the work of the man, or men, in direct charge of operation and maintenance of these facilities. May I suggest that the members of this committee, as well as the men actually engaged in operation and maintenance work, should be members of the California Sewage Works Association. They should read the publications of this Association and attend its conventions.

Many communities of the State have adopted the practice of paying the dues of these men and of sending them to the conventions of the Association as a city expenditure and, in doing so, have secured large dividends for their community and in more satisfactory and less costly operation of sanitary facilities.

These conventions are attended by operators, engineers, public health officials, city managers and others from all over the State who gather to discuss practical problems and to exchange ideas with others who have had similar experiences.

Membership is four dollars per person, per year, and entitles the member to the publications, both of the California Association and the National Association, which contain the most advanced papers regarding sewage works and other matters vital to the public health of communities such as yours.

I would recommend that you make sure that at least one official of your city is a member of this Association and that you send him to the Fall Meeting which will be held this year in Los Angeles on September 20, 21 and 22. I believe it will pay you dividends.

This Association is not a new thing. It has been organized for 15 years and is nationally recognized for its work in this particular field. Its membership includes men who have attained national recognition for their work as well as men operating some of the smallest plants in the State and every member will tell you of the benefits which he has derived from the Association.

An application for membership is enclosed. If more are needed they can be obtained from the Secretary, Mr. Jack Kimball, or myself.

Sincerely yours,

ARTHUR PICKETT, Chairman
Membership Committee.

CALIFORNIA STATE CHAMBER OF COMMERCE
RESEARCH DEPARTMENT
ECONOMIC SURVEY SERIES 1940-41 — REPORT No. 19
POPULATION — CALIFORNIA CITIES OF 10,000 OR MORE
1940 PRELIMINARY RETURNS

City	CENSUS OF POPULATION Jan. 1, 1910	Jan. 1, 1920	April 1, 1930	% Increase Over 1920	*Prel. Apr. 1 1940	*% Increase Over 1930
*Alameda	23,383	28,806	35,033	21.6	35,133	0.3
Albany	808	2,462	8,569	248.1	11,420	33.3
Alhambra	5,021	9,096	29,472	224.0	38,820	31.7
Anaheim	2,628	5,526	10,995	99.0	11,020	0.2
Bakersfield	12,727	18,638	26,015	39.6	27,694	6.5

City	CENSUS OF POPULATION Jan., 1, 1910	Jan. 1, 1920	April 1, 1930	% Increase Over 1920	*Prel. Apr. 1 1940	*% Increase Over 1930
Bell	†	†	7,884	†	11,135	41.2
Belvedere Twp	†	†	33,023	†	37,058	12.2
Berkeley	40,434	56,036	82,109	46.5	84,827	3.3
Beverly Hills	†	674	17,429	2485.9	26,346	51.2
Brawley	881	5,389	10,439	93.7	11,722	12.3
Burbank	†	2,913	16,662	274.0	34,090	104.6
Burlingame	1,565	4,107	13,270	223.1	15,897	19.8
Colton	3,980	4,282	8,014	87.2	10,692	33.4
Compton	922	1,478	12,516	746.8	15,892	27.0
El Centro	1,610	5,464	8,434	54.4	10,031	18.9
*Eureka	11,845	12,923	15,752	21.9	17,017	8.0
Fresno	24,892	45,086	52,513	16.5	60,644	15.5
Fullerton	1,725	4,415	10,860	146.0	11,404	5.0
Glendale	2,746	13,536	62,736	363.5	81,744	30.3
Huntington Park	1,299	4,513	24,591	444.9	28,222	14.8
Inglewood	1,536	3,286	19,480	492.8	29,813	53.0
Lodi	2,697	4,850	6,788	40.0	11,100	63.5
Long Beach	17,809	55,593	142,032	155.5	163,441	15.1
Los Angeles	319,198	576,673	1,238,048	114.7	1,496,792	20.9
Lynwood	†	†	7,323	†	10,950	49.5
Maywood	†	†	6,794	†	10,683	57.2
Merced	3,102	3,974	7,066	77.8	10,141	43.5
Modesto	4,034	9,241	13,842	49.8	16,381	18.3
Monrovia	3,576	5,480	10,890	98.7	12,784	17.4
Monterey	4,923	5,479	9,141	66.8	10,000	9.4
National City	1,733	3,116	7,301	134.0	10,204	39.8
Oakland	150,174	216,261	284,063	31.4	304,909	7.3
Ontario	4,274	7,280	13,583	86.6	14,163	4.3
Palo Alto	4,486	5,900	13,652	131.4	16,728	22.5
Pasadena	30,291	45,354	76,086	67.8	81,566	7.2
Pittsburg	2,372	4,715	9,610	103.8	11,769	22.5
Pomona	10,207	13,505	20,804	54.0	23,472	12.8
*Redlands	10,449	9,571	14,177	48.1	14,396	1.5
Redondo Beach	2,935	4,913	9,347	90.3	13,246	41.7
Redwood City	2,442	4,020	8,962	122.9	12,322	37.5
Richmond	6,802	16,843	20,093	19.3	22,707	13.0
Riverside	15,212	19,341	29,696	53.5	35,967	21.1
Sacramento	44,606	65,008	93,750	42.2	105,748	12.8
Salinas	3,736	4,308	10,263	138.2	11,575	12.8
San Bernardino	12,779	18,721	37,481	100.2	44,373	18.4
San Buenaventura	2,945	4,342	11,603	179.2	12,464	7.4
San Diego	39,578	74,683	147,995	99.0	202,038	36.5
San Francisco	416,912	506,676	634,394	25.2	629,552	-0.8
San Gabriel	†	2,640	7,224	173.6	11,842	63.9
San Jose	28,946	39,642	57,651	45.4	68,298	18.5
San Leandro	3,471	5,703	11,455	100.9	13,656	19.2
San Mateo	4,384	5,979	13,444	124.9	19,367	44.1
Santa Ana	8,429	15,485	30,322	95.8	33,111	9.2
Santa Barbara	11,659	19,441	33,613	72.9	34,438	2.5
Santa Cruz	11,146	10,917	14,395	31.9	16,829	16.9
Santa Monica	7,847	15,252	37,146	143.5	52,828	42.2
Santa Rosa	7,817	8,758	10,636	21.4	12,548	18.0
South Gate	†	†	19,632	†	26,860	36.8
South Pasadena	4,649	7,652	13,730	79.4	14,264	3.9
*Stockton	23,253	40,296	47,963	19.0	54,513	13.7
Vallejo	11,340	21,107	14,476	-14.1	19,803	36.8
*Whittier	4,550	7,997	14,822	85.3	16,051	8.3

*Preliminary 1940 figures released by U. S. Bureau of the Census are incomplete and subject to later revision. †Not reported.

REPORT OF LEGISLATIVE COMMITTEE

We would refer to report of this Committee made to the Association on October 14, 1941, to cover legislation enacted during the 54th session of the State Legislature in 1940 and 1941, which particularly concerns sewage works operators.

The First and Second Extraordinary Sessions of the 54th Legislature were held between December 19, 1941, and January 22, 1942, and between January 17 and 18, 1942, respectively. These sessions were primarily concerned with legislation on financial matters and the State Guard, and no matters concerning sewage works operations or sewage disposal were considered. A few enacted statutes listed below are, however, of general interest:

S. B. 3 (Ch. 1). New act, re public funds.
Permits cities, counties and districts, on 4/5 vote of governing board, to expend public funds and use public property to meet war emergencies regardless of budget limitations or other limitations imposed by law.

A. B. 26 (Ch. 5). Adds secs. 395.6 and 395.7, Mil. & Vet. C., re reemployment rights of State Guard members.
Grants active State Guard members same rights as to their public employment as have members of U. S. armed forces.
Requires private employers to reemploy active State Guard members without loss of rights because of absence if application made within 40 days after discharge from service and ex-employee still qualified, provided such reemployment is neither impossible or unreasonable. Prohibits discharge without cause for one year after reemployment. Provides for action in superior court to demand such reemployment, with petitioner represented by district attorney.

S. B. 36 (Ch. 19). California Guard Act of 1942.
Provides for organization and size of State Guard.

Respectfully submitted,
CARL M. HOSKINSON, *Chairman.*

REPORT OF THE SAN JOAQUIN SECTION

In accordance with the provisions of the constitution and by-laws of the San Joaquin Section of the C. S. W. A., I hereby submit a report of the membership, activities and finances of the Section.

The Section has 15 paid up members for 1941. There were four meetings held during this year in the following towns: Lodi, Manteca, Stockton and Tracy.

Balance on hand October 1, 1941, $0.25. Income from dues, $3.75. Total, $4.00. Paid out for cards for four meetings, $2.00, leaving balance on hand October 1, 1942 of $2.00.

Respectfully submitted,
F. WAYLAND JONES, *Secretary-Treasurer.*

REPORT OF DESIGN PRACTICE COMMITTEE

After completing a study on design factors for sedimentation units, the Fact Finding Committee on Design Standards assembled some information on separate digestion tanks, but the great pressure of other work experienced by most members of the Committee prevented any real progress in this new study. Consequently the Committee is unable to present a useful report at this time, and since there is little prospect that much could be accomplished while the present war conditions prevail, it is suggested that the Committee should not be re-appointed at this time.

Respectfully submitted,

RICHARD D. POMEROY, *Chairman.*

REPORT OF INDUSTRIAL WASTES COMMITTEE

The Committee in 1941 outlined quite ambitious plans of what it desired to accomplish in obtaining data on industrial waste in the larger cities of our State. On January 2 of this year, President Bowlus reappointed the personnel of the 1941 Committee and added the names thereto of four others, thus making a total of twelve on the Committee.

On February 13 the Committee met in Los Angeles to outline its work for 1942. As a quorum was present, it was agreed that the plan of obtaining data on industrial waste should be continued and that each member of the Committee should contribute his share in doing the research work required. However, on account of the war, the Committee agreed that the plans proposed in 1941 should be simplified as follows:

First, it was desired to obtain information from the larger cities as to the number of industries of the different types in each city, such as laundries, canneries (all kinds), breweries, bottling plants and others.

Second, for each industrial plant of the same type, the number of units used was desired, which data can be used in the design of the treatment required, as well as making comparisons of plants of the same type. For laundries the units would be the number of tubs; for creameries the number of 1000 pounds of milk produced daily; for canneries the tonnage packed daily; for breweries the number of barrels of beer, and for bottling works and bottle washers, the number of washers.

Third, a record was wanted of the volume of waste discharged from the plant into the sewers that has caused no trouble or deterioration in the sewerage system. If such trouble has occurred, what means have been used to remedy the matter. The amount of water supply furnished to each plant was also desired.

After assigning to the different members of the Committee those cities for which the above information was wanted, a second meeting of the Committee was called for on April 20 to canvass the data obtained. However, the Committee as a whole were not prepared then to submit their findings, and since the spring meeting at Bakersfield, the Committee has as a rule been too busy at war work to get together. This situation accordingly makes it necessary that the Committee be given more time to compile and publish its findings, which the writer, as chairman, recommends be granted.

W. T. KNOWLTON, *Chairman.*

REPORT OF REVISION OF CONSTITUTION COMMITTEE

One matter was referred to this committee by the Governing Board at its Bakersfield meeting in April, viz.: the dues to be charged our dual members who receive the Federation publications through their home Association. Our committee was unanimous in the feeling that it was unnecessary to make any change in our Constitution or By-laws to cover the few dual members involved. We suggested that where such dual membership exists the funds which would ordinarily cover the cost of the second set of Federation Journals should not be charged. We believed this matter could best be handled between secretaries of the Associations involved. In our case probably the members of the Arizona Association are the ones involved, and such members would be carried on our list as regular members.

Respectfully submitted,

L. B. Reynolds, *Chairman*

REPORT OF PUBLICITY COMMITTEE

It is with pleasure that I report on the activities of the Publicity Committee for the year of 1942.

During this year most of the publicity was carried on by the local members in the two convention cities.

I have a very fine committee serving with me, and I am sorry that I haven't more to report.

Respectfully submitted,

F. Wayland Jones, *Chairman*

REPORT OF JOINT COMMITTEE ON SCHOOLS FOR AND CERTIFICATION OF WATER AND SEWAGE WORKS OPERATORS

In presenting this report on the work during 1942 of the school and certification committee, it should be recorded first of all that our efforts have been a little on the feeble side and our achievements even more so. Under current conditions there is a natural lack of interest in committee activities and it is impossible to carry on any program requiring more than casual participation. As a result, there has been no school for plant operators and no attempt has been made to continue the regional conference idea so ably initiated two years ago by G. E. Arnold.

In the past, a lot of work has been done in organizing short-course schools and other opportunities for instruction, but there has generally been some question as to whether the energy so expended was altogether justified. Some good has come of it, of course, as there are always a few operators who are genuinely interested in their work and are therefore anxious to pick up anything that looks like helpful information. On the other hand, if nothing of permanent value has been taken away by the majority of the men who attended the previous schools and discussion groups, there would seem to be no point, even in normal times, in doing further work along the same line.

Our efforts this year have been confined to offering a new type of in-

struction and to determining the extent of operator interest in our educational and certification program. As a first step, we sent out an announcement and questionnaire to all of the known water and sewage treatment plants, using a mailing list which was made available through the courtesy of the Bureau of Sanitary Engineering of the State Department of Public Health.

The announcement introduced two innovations. Of these, the first provided for instruction by correspondence and the second for an increase in the number of places where eligible operators could take the oral and written examinations required in applying either for a new certificate or for a higher rating. By sending the questionnaire at the same time, we hoped to find out how the men on the job were reacting to the efforts of the committee and whether there would be any real interest in the new method of instruction.

Response to the questionnaire was rather discouraging. For water treatment plants there were 18 replies to the 62 that went out and of these 12 were from plants under the direct supervision of various members of the committee. In the sewage field there were 18 replies out of 70, making in all a total of 36 on the 132 that were sent out in the first place. Hence, with an average return of less than 30 per cent, it hardly seemed worth while to put in the time and effort it would have taken to prepare a suitable syllabus for home study. It was apparent, furthermore, that no one syllabus could be written which would cover the variety of information set forth in the replies to the questionnaire.

A second announcement was sent out early in September. In this the failure of the first effort was reported and the operators were advised of a substitute plan providing for the following type of advisory service:

1. Furnish information on what books and publications should be studied in order to obtain the type of information most desired.

2. Provide an opportunity, if such is wanted, for brief training in laboratory methods applicable to treatment plant control. Several laboratories are available for this purpose.

3. Advise operators as to nature of material to be covered when taking an examination for any one of the three grades of certificates.

Response to this second announcement was even more discouraging. A few answers came in but the reaction in general was one of complete indifference. It seems fairly obvious, therefore, that nothing of any significance is going to be accomplished for the duration of the present emergency. When the war is over, the school and conference program could be reestablished, although it appears now that the necessary time and effort are not altogether justified. If at all possible, it would be better instead to promote a plan whereby needed instruction would be given at each treatment plant by one man or by a group of men employed especially for that purpose. This work would have to be carried on by a state agency, presumably the Bureau of Sanitary Engineering, and would be designed primarily to help those plants which are not large enough to justify the employment of a technically trained superintendent. Paid advisers traveling in mobile laboratory units would bring an end to the school and conference problem and would raise to a consistently high level the performance of those water and sewage works

which now suffer for want of competent supervision. This, of course, is all very vague but there is nevertheless a possibility that something of the sort might ultimately become a reality. In any event, it seems that little of permanent value can be expected from our present efforts.

FINANCIAL STATEMENT

INCOME:

From Secretary A.W.W.A.	$25.00
From Secretary C.S.W.A.	25.00
C. F. Ellis, Water Applicant	1.00
W. J. Walker, Sewage Applicant	1.00
Total income	$52.00

EXPENSES:

Material for mimeographing letters and announcements	$ 3.75
Stamps	11.00
Envelopes	3.70
Total expenses	$18.45

Cash on hand: $33.55

Due A.W.W.A.	$16.77
Due C.S.W.A.	16.78
	$33.55

Respectfully submitted,

Joint Committee on Certification and
Schools for Water and Sewage Operators
Calif Sewage Works Association
Calif. Sec. Amer. Water Works Assn.
K. W. BROWN, Chairman.

REPORT OF COMMITTEE ON PUMP AND MOTOR STANDARDS

After some correspondence between members of the Committee and a conference with representatives of various pump and electrical dealers, your Committee has drafted a set of standard specifications for sewage pumps, motors and controls applicable to war conditions, which we hand you herewith. While these specifications are drawn up quite rigidly, provision is made for easy amendment to satisfy the needs or desires of the purchaser.

Since these specifications should be placed in the hands of engineers to be useful, it is recommended that some means be provided for distributing them to those who would be interested as soon as convenient.

Respectfully yours,
H. K. PALMER, *Chairman*

(For Pump and Motor Specifications, see Page 89)

REPORT OF THE SECRETARY-TREASURER FOR THE YEAR 1942

As of September 1, 1942

Account	Receipts	Disbursements
General	$ 477.72	$ 16.35
Secretary	....	235.06
Convention	81.20	76.23
Award	35.00	40.00
Journal	670.59	788.12
Journal subscriptions and sales	21.00	....
Schools for Operators	21.14	28.30
Certification of Operators	30.61	....
Dues, 1941	22.00	17.00
Dues, 1942	932.53	687.00
TOTAL	$2,291.79	$1,888.06

Cash Balance in the Bank $ 403.73

BALANCE OF ACCOUNTS

Account	Balance	Deficit
General	$ 226.31	$ ....
Convention	4.97	....
Award	....	5.00
Journal	....	96.53
School	....	7.16
Certification	30.61	....
Dues, 1941	5.00	....
Dues, 1942	245.53	....
TOTAL	$ 512.42	$ 108.69

Cash Balance in the Bank $ 403.73

Bills outstanding as of September 1, 1942 $ ....

Assets outstanding as of September 1, 1942 127.50

Currie Engineering Co.	$ 10.00
Inertol Company, Inc.	12.50
Dow Chemical Co.	30.00
Vapor Recovery Systems Co.	25.00
Everson Manufacturing Co.	25.00
Pennsylvania Salt Manufacturing Co.	25.00
Total	$ 127.50

CERTIFICATION OF OPERATORS' ACCOUNT

Item	Receipts	Disbursements	
1941 Balance Brought Forward	$ 29.61	$	
Fee collected from Thomas M. Gwin	1.00		
Totals	$ 30.61	$	
Balance on Hand			$ 30.61

SCHOOLS FOR OPERATORS' ACCOUNT

Item	Receipts	Disbursements	
1941 Deficit Brought Forward	$	$ 3.30	
1941 Working fund returned by Ray Derby	21.14	....	
1942 Working fund to Kenneth W. Brown		25.00	
Totals	$ 21.14	$ 28.30	
Deficit			$ 7.16

Respectfully submitted,

JACK H. KIMBALL, *Secretary-Treasurer.*

CALIFORNIA SEWAGE WORKS JOURNAL FINANCES

	Volume XIV, Numbers 1	and 2	
Number of Copies Printed	400	400	
Number of Pages including Covers	106	80	
Pages of Advertisement	12	12½	
Professional Cards	3	3	
INCOME:			
From Advertisement—Received	$327.50	$235.00	$562.50
From Advertisement—Outstanding	5.00	110.00	115.00
Total from Advertising	332.50	345.00	677.50
From Journal Sales	3.00	8.00	11.00
Total Income	$335.50	$353.00	$688.50
EXPENSES:			
Printing and Mailing	$356.17	$265.19	
Miscellaneous	3.50		
Total Expenses	$359.67	$265.19	$624.86
Balance of Income over Expenses			$63.64

A SANITARY SURVEY OF SEWAGE POLLUTION OF THE SURF AND BEACHES OF SANTA MONICA BAY

By **ELMER BELT, M.D.***

During the past ten years, the amount of raw sewage reaching the shores of all the cities along Santa Monica Bay has been increasing to an alarming extent. The mounting danger of epidemic disease, and the increasing filthiness of the beaches from the sewage grease was recognized throughout this period by the California State Board of Public Health.

Population growth in this area has been extremely rapid. At the present time within Los Angeles and the area immediately surrounding the city is the third greatest concentration of population in the United States. The sewage from this multitude of people is in large part poured into the sea at Hyperion Beach. Even the great sewers which carry this material are overtaxed and the north outfall sewer has developed seams which place it in danger of bursting during every storm. In such an event, the low country below this sewer, used for vegetable growing, would become flooded with raw sewage. Realizing this latter danger, in the summer of 1941 the city of Los Angeles applied to the California State Board of Public Health for a permit to by-pass the north outfall sewer into Ballona Creek at Culver City during the height of each storm. It was this emergency need which brought the entire problem to the immediate attention of the city and county authorities and to the California State Board of Public Health. Permission to operate the sewage plant and outfall is granted only on a yearly basis at the present time, on stipulation that Los Angeles City offer plans and take steps to modernize the sewage disposal plant at Hyperion Beach.

As the result of widely divergent political and economic viewpoints, it was finally necessary to call a special meeting of the California State Board of Public Health in which the problem was discussed by all governmental and private agencies and by citizens. This was done on August 21, 1941. Because of the wide scope of the problem, involving large expenditures and the cooperation of many incorporated cities with Los Angeles, it was necessary to conduct a detailed investigation of the entire problem. The start of the war then made procurement of some of the materials for a new plant very difficult. In order to bring the whole picture before the mind of the public, the California State Department of Public Health undertook this detailed investigation.

The study was instituted by the Director of the Department, Dr. Bertram Brown, under the able leadership of the head of the Department of Sanitary Engineering, Mr. C. G. Gillespie. The technical field work was done by Mr. Robert A. Heller. The Governor provided special funds for the study from his own budget. The present Director of the California State Board of Public Health, Dr. Wilton L. Halverson, is collaborating with Mr. Gillespie and Mr. Heller in the preparation of a detailed report of the findings result-

*President, California State Board of Public Health.

ing from this valuable study. This report will be printed for distribution by the State Department of Public Health.

Sewage Disposal Works

The Los Angeles Sewage Plant known as "Hyperion Sewage Plant" is located opposite the city of El Segundo slightly south of the center of the bay shoreline. The plant has been in operation since 1923. It is composed of 10 revolving cylinder screens. Each screen is 10 x 12 feet and has screening slots two inches long and 2/32 inch wide. Each screen is capable of handling 33 cu. ft. of flow per second. Shortly before the present war the slots on two of these screens were increased to a diameter of 3/32 inch. This gave each of these two screens a 50% increase in capacity. Large bar screens remove the large material and rocks in two intake channels to prevent possible damage to the bronze screens. The peak flow of sewage in the afternoon frequently is greater than the present capacity of the plant. The run-off in the storm drains from the heavy rains also always creates a flow beyond the capacity of the plant. Excess flow is by-passed around the screens into the submarine outfall, or when the flow is too excessive it is by-passed completely around the intake of the plant and flows out of a concrete pipe at about high tide line directly onto the beach. The screens remove from 5% to 8% of the total solids which are blown by compressed air to presses and heat driers. This humus is then sold to a fertilizer company. The screened sewage effluent passes out through a concrete submarine pipe which is 5 feet in inside diameter. The mouth of the pipe is 5000 feet directly off shore at which point the ocean water is about 54 feet deep.

The sewage rises to the surface of the ocean immediately as it flows from the pipe. On calm days a wide grease sleek field can be observed with a brown bile stained turgescent area over the mouth of the pipe. In addition to several small breaks in the pipe, there are two large ones that discharge sewage very close to shore. One is at mid-tide line where the sewage discharges through the sand like an artesian well. The other is approximately 400 feet off shore, and during the peak flow in the afternoon, it escapes under pressure great enough to cause a small geyser three feet above the surface of the ocean. Most of the beaches along Santa Monica Bay are becoming increasingly filthy from the sewage grease which in addition frequently carries a strong odor of grease, and sometimes septic stench.

Field Investigations

Because of the effect of the weather and wind on the plant operation and on the ocean current, the influence of the air and ocean temperatures, seasonal changes, and other factors, it was deemed necessary to conduct the survey for one entire year throughout the four seasons from January through December, 1942.

The purpose of the investigation was to gain actual evidence of the amount and condition of the sewage debris on beaches and surf, study the operating conditions of the sewage plant, observe the condition and operation of the outfall, make a detailed study of wind and weather behavior, air and ocean temperatures, observe and record all types of ocean currents and factors

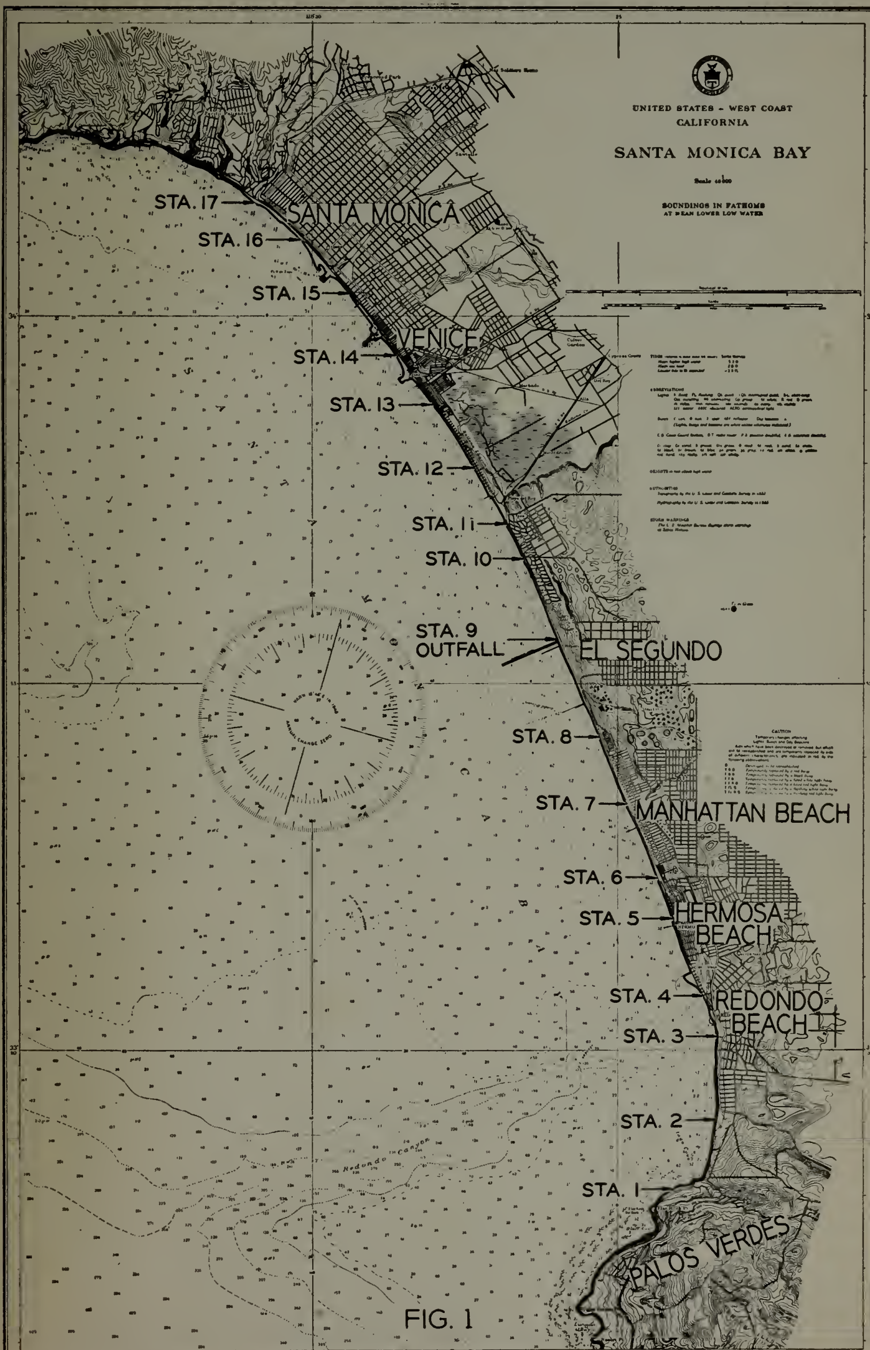

UNITED STATES - WEST COAST
CALIFORNIA
SANTA MONICA BAY
SOUNDINGS IN FATHOMS
AT MEAN LOWER LOW WATER
STA. 17
SANTA MONICA
STA. 16
STA. 15
VENICE
STA. 14
STA. 13
STA. 12
STA. 11
STA. 10
STA. 9
OUTFALL
EL SEGUNDO
STA. 8
STA. 7
MANHATTAN BEACH
STA. 6
STA. 5
HERMOSA
BEACH
STA. 4
REDONDO
BEACH
STA. 3
STA. 2
STA. 1
PALOS VERDES

FIG. 1

influencing them, culture samples of surf and polluted sand, to isolate intestinal bacteria, and record the size and geographical distribution of the crowds at the beach.

For purposes of systematic study, seventeen stations were located along the bay at which regular observations were made. The stations were from three-fourths to one and one-half miles apart. They start with station No. 1 at Palos Verdes on the south and ended at station No. 17 at Santa Monica Canyon just north of Santa Monica City. The sites were chosen so as to enable the study of the effect of various geographical factors and breakwaters along the shore, and at the same time to secure an even distribution of the observation points along the bay. The beach at the outfall itself is station 9, thus there were eight stations both to the north and to the south for a distance of approximately eight miles each way. The location of these stations may be seen on the map, Figure 1.

Inspection trips to all the stations were made at least twice a week. Samples of the surf for culturing were taken once a week. The data recorded included the time of observation at the station, direction and velocity of the wind, direction and approximate strength of ocean currents, condition of the water, i.e., whether polluted with sewage or not, odor of beach and surf. The debris on the beaches was recorded as non-sewage debris including marine, storm debris, shipping, garbage, lunch, tar, and oil. Sewage debris was recorded as sewage grease, soap, kitchen matches, condoms and feces. The conditions of the beaches from a standpoint of erosion, etc., were also reported. The sewage plant was visited at each inspection trip and its condition of operation recorded, including the amount of by-passing.

A detailed report and analysis of the entire year's study cannot be attempted here. The State Department of Public Health is now preparing a complete detailed report of the entire survey which will include careful analysis of all the observations and statistical data obtained.

Relationship of Wind, Ocean Surface Currents and Spread by Sewage Debris:

A complete record of the direction and velocity of the wind during every hour of the day was kept for the entire year. These were correlated with the directions and strength of the ocean surface currents.

Santa Monica Bay is very shallow except for a narrow deep canyon in the southern section extending southwest off Redondo Beach. The natural current in calm weather when there is no influence of wind is not over one-tenth of a mile per hour, and often is practically zero. Wind creates a surface current with a velocity of approximately 2% of that of the wind. Observations of the shape of the sewage grease sleek field on the ocean surface at the outfall, floating objects and moored boats disclose that the surface currents on calm days were frequently negligible in a north and south direction, the only movement being in-shore and off-shore in a tidal direction. Whenever the wind velocity became five miles per hour or faster, a definite surface current was set approximately in the direction of the wind. These changes could be observed in the changing shape of the sewage grease sleek field of the outfall. The relative strength could also be estimated by

observation of light floating objects. There is a characteristic cycle of the winds in this locality through a 24-hour period. From mid-morning until evening the prevailing wind is from the southwest. On some days it may be more from the west during the same time, with varying amounts of south wind in certain seasons. During the night until midmorning, the prevailing wind is from the northeast. Northwest winds may occasionally interplay.

In the morning during the shift from north to south, east and southeast winds may be active to a mild degree. Observations have shown that the southwest wind created a current that carried most of the grease sleek field on to shore over a distance of approximately four and one-half miles to the north of the outfall between stations 13 and 14. Lesser amounts of the grease were carried farther north. The west wind created an on-shore current slightly to the south of the outfall so that nearly the entire grease sleek field reached shore within a distance of a mile and a half to two miles from the outfall to station 7. The south wind created a sleek field to the north almost parallel to the shore line with very little of the grease reaching shore until it had passed station 14. The result was that stations 15, 16, and 17, which were six, seven, and eight miles north of the outfall respectively, received considerable amounts of the sewage. East winds created a directly off-shore current which prevented most of the grease from coming ashore even at the outfall itself. These winds were usually weak and brief. Thus the sewage grease was later carried in the direction of the stronger succeeding wind. The northeast wind created a slightly off-shore current to the south. However, more sewage is deposited at station 5 than at station 6, which is one mile nearer the outfall. It was found that the northeast wind created the southeasterly off-shore current that by-passes station 6. The combination of southwest winds following the northeast wind, and a type of in-shore eddy in the current brought most of this grease inshore at station 5. Because of the time of day during which the characteristic winds prevail, the sewage grease is usually deposited in greatest amounts at stations 1 to 6 during the night or early morning, whereas the other stations receive it during the daytime when the south or westerly winds usually prevail. There were some variations in the actual duration of the wind with the changing seasons so that occasionally the wind might prevail in one direction during almost the entire day and rarely during the full 24 hours. On inspection trips, it was characteristic to find a beach with a large amount of sewage grease on it when the surf itself was relatively clean, because the grease had been deposited at an earlier hour before the ocean had changed its direction. At the same time, another beach might have very little grease actually upon the sand but the surf itself would be very thickly polluted and just beginning to deposit wave rows of fresh sewage on the sand.

Laboratory Work

Samples of surf were taken at each station once a week. The samples were collected in sterile four-ounce bottles suspended from the end of a 20-foot pole extended out and into the surf. A total of 45 to 47 samples were cultured for Escherichia coli at each station during the year. If the samples could have been taken during the night as well as during the day,

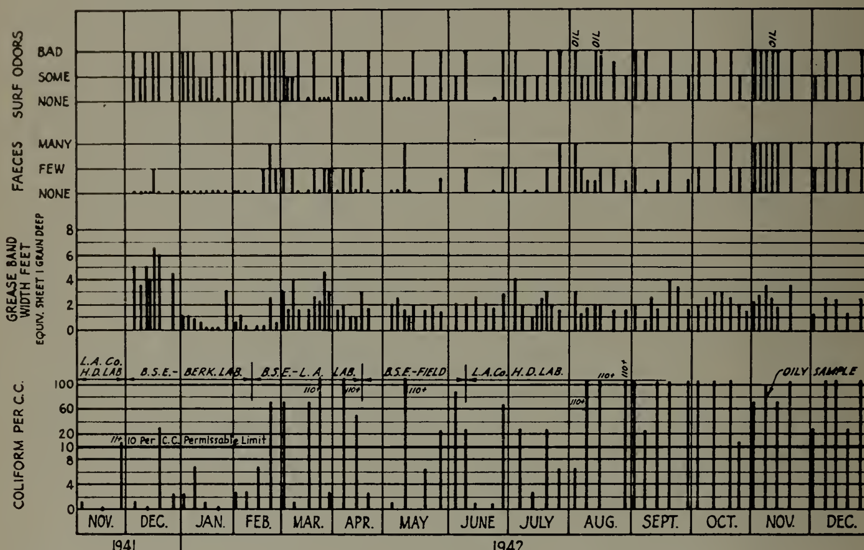
STATION 8

LOS ANGELES COUNTY

FIG. 3

EL PORTO BEACH

45TH AVE.

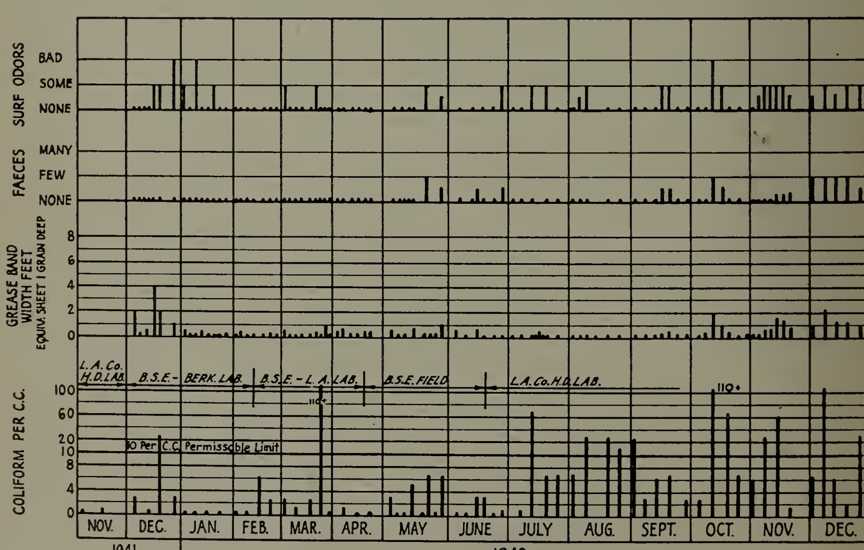


STATION 5

HERMOSA BEACH

FIG. 2

3 BLOCKS NORTH OF PIER



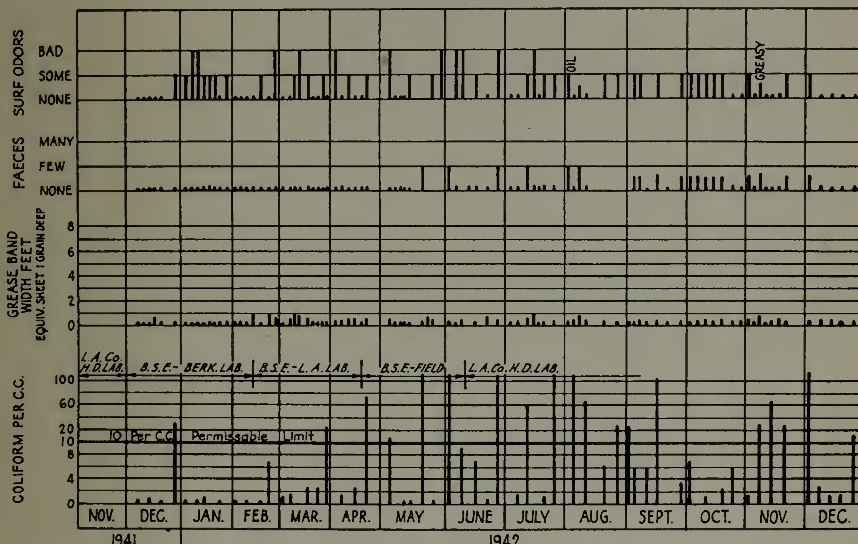
STATION 13

LOS ANGELES CITY

FIG. 6

VENICE

26TH AVE.



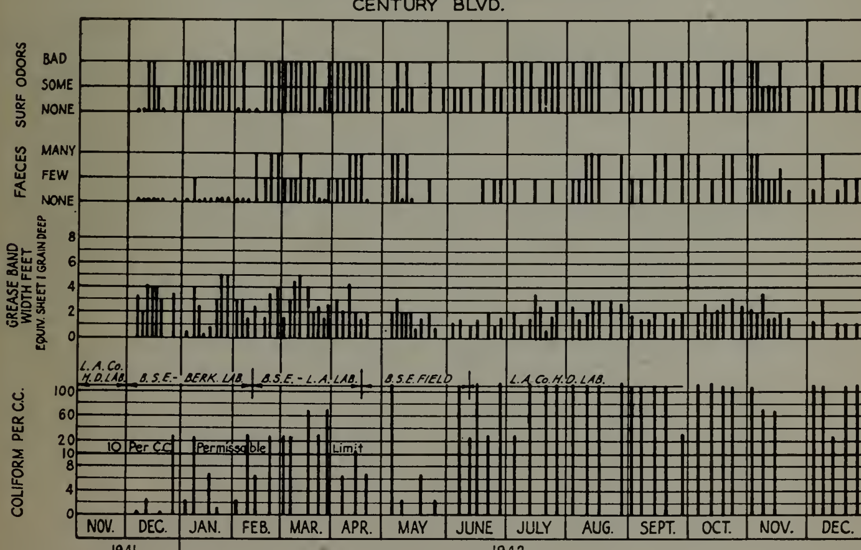
STATION 10

LOS ANGELES CITY

FIG. 5

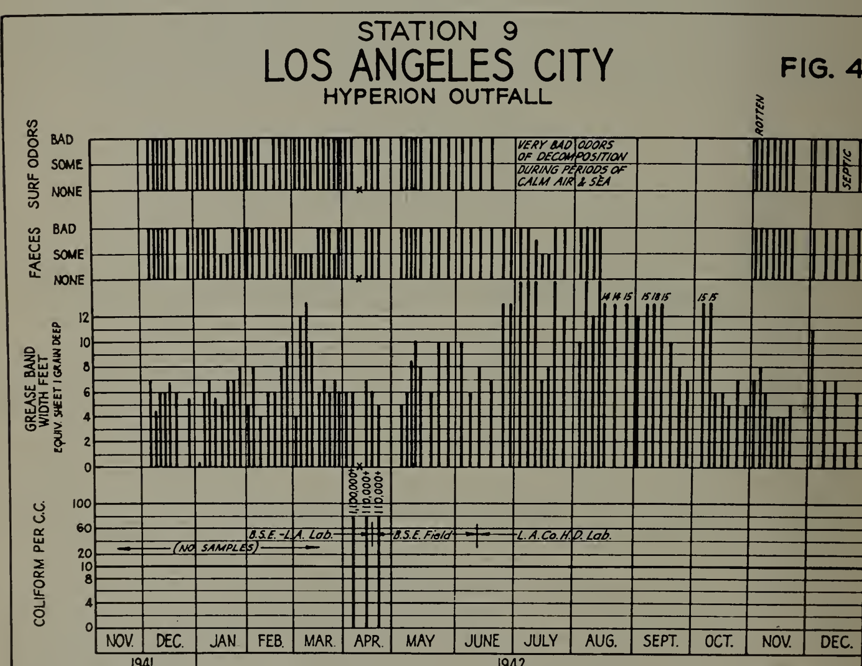
PLAYA DEL REY LIFE GUARD STATION

CENTURY BLVD.



a very much greater number of them would have been found to contain coliform bacteria in excess of 10 per c.c. because of the changing currents. However, since the surf was cultured throughout the entire year the results give a fair picture of the degrees of pollution along the bay, and show the characteristic seasonal shifts.

Samples were also taken of the mixture of sewage grease and debris and sand left in rows on the beaches by the waves. Ten cc. portions of the polluted sand were ground in a sterile mortar and mixed with 10 cc. of sterile water. This was then cultured in the same amounts as was the surf. At least two of such samples were taken at stations 5 to 15 inclusive during the year. All the cultures were positive for Escherichia coli in amounts from 24 to 110 plus per cc. The length of time sewage grease remained on the beaches depended upon the character of the tides, and the degree of erosion of the beaches. The higher high-tide every two weeks usually changed most of the marine-borne debris on the beaches. During the summer much of the grease melts in the hot sand and perfuses down through it. The result is that the sand on the heavily polluted beaches has become darkened, sticky and caked. The samples of polluted sand that were cultured were all from one hour to 24 hours old.



Figures 2 to 6 illustrate the amount of pollution on the sand by sewage grease, the presence of recognizable feces and odor of the stations. Station 5 was four miles south of the outfall, station 8 slightly over a mile south, sta-

tion 9 is right at the outfall itself, station 10 is one mile north, station 13 is four miles to the north. The data on these charts show an almost equal distribution of the sewage grease the first four miles north and south of the outfall. However, at a distance of four and one-half miles south and on through stations 4 to 1 the beaches are usually free from grease and receive it in a very slight amount, compared to uniformly regular distribution of the grease in diminishing amounts all the way to station 17, eight miles north. Results of the cultures of the surf indicate a seasonal change. This is in harmony with the seasonal changes of the winds mentioned above. Stations 8 and 10 receive large amounts of pollution nearly every day of the entire year. Station 13, four miles to the north, receives its greatest amounts during the spring and summer when the southwest wind prevails. The stations farther to the north receive their greatest pollution during the same period. However, there is enough variation in the weather conditions to cause a spread of the sewage grease to all the stations from 5 to 17 inclusive during every month of the year.

Number of coliform bacteria per cc.	STATIONS																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
10 or more	1	2	1	2	13	11	23	36	*	41	33	25	20	10	12	5	10
6 to 10	1	1	1	3	13	8	4	4	*	4	7	8	8	5	7	7	4
Less than 6	11	17	15	19	18	17	10	7	*	2	7	13	19	23	18	16	15
0 in 1 cc. of sample	34	27	30	23	3	11	19	0	*	0	0	1	0	9	10	19	17
Total samples cultured	45	45	45	46	47	46	47	47	*	47	47	47	47	47	47	47	46

NOTE: On three occasions 10cc of sample was cultured from each station. All 10 cc. samples were positive for Escherichia coli at every station.

*Sewage outfall: Samples not regularly cultured. Escherichia coli found 100,000 to 1,000,000 per cc.

Figure 7.

Figure 7 is a table of the complete results of cultures from all stations during the year. All samples were cultured in duplicate tubes of 1 cc., 0.1 cc., and 0.01 cc. The figures show a greater number of samples having 10 or more coliform bacteria per cc. from the stations north than from those south of the outfall. This is in harmony with the fact that the southwest wind is present in sufficient velocity most of the year, although it reaches its greatest strength in the spring. Although the northeast wind is also present during its customary time most of the days during the year, its velocity in the spring and summer is usually too weak to create a strong surface current in the ocean. The length of beach for a mile and a half each side of the outfall, that is, from the vicinity of station 8 to slightly beyond station 10, receives some sewage practically every day of the year. When the winds are not in effect, there is usually a slow natural shifting in-shore current which brings the grease on to the beaches within this distance.

In examining the sewage grease pellets in the wave rows on the beach some of them were found to be small bits of feces from one-sixteenth to one-fourth inch in diameter which were coated with grease. When these pellets were squeezed, brown feces extruded from within the grayish grease coating.

It had the characteristic appearance and odor of feces. Fecal material breaks up quickly in the sewer. Only a relatively small amount reaches the sewage plant in pieces as large as 1½ inches. Most of it is three-fourths inch or less. It breaks into much smaller pieces in the screens and becomes coated with grease. Much of it escapes through the slots, and through the breaks in the screens. However, when the sewage is by-passed easily recognizable feces up to one and one-half inch size can be found on the beaches. Careful examination of the grease on all the beaches would have been much too time consuming. No effort was made to determine the amount of grease-covered feces, and the charts only indicate when feces was recognized. The photographs, Figures 8, 9 and 10, illustrate such conditions.

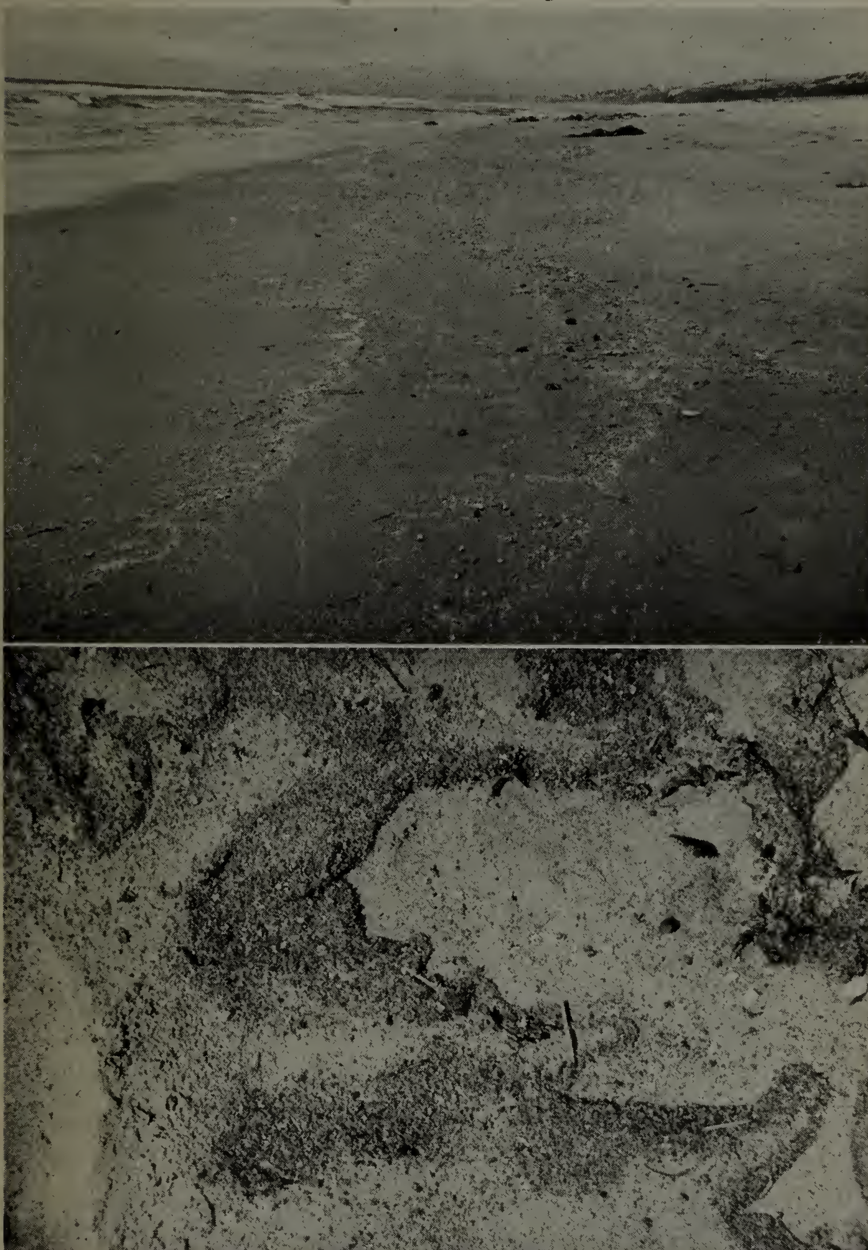
Degree of Pollution of the Surf:

Samples of the surf right at the outflow were not regularly cultured for coliform bacilli. Five samples taken during a period of two months were found to contain Escherichia coli in the amount of 100,000 per cc. Two of the five samples contained 1,000,000 coli per cc. Because of this, it was not considered necessary to run any more cultures of this surf. Simultaneously with the making of these maximum dilution cultures of the surf at the outfall, similar tests were made of the samples obtained at stations 8 and 10. Two samples each at stations 8 and 10 and one at station 8 contained 2,000 Escherichia coli per cc. One sample each at stations 8 and 10 contained 1,000 Escherichia coli per cc.; the others contained 500 or less per cc. All of these samples showed gross pollution with sewage. However, a distance of one mile or more from the outfall, the count falls even in grossly polluted surf. Doctor Claude E. ZoBell of the University of California and Scripps Oceanographic Institute, experimentally found that natural sea water had a bacteriocidal action on sewage bacteria. A series of survival tests of Escherichia coli in the polluted surf were made as a part of this survey. Results indicate that there is a regular death rate of Escherichia coli in natural sea water that rapidly reduces its numbers in a few hours' time. However, a few survivors were found viable in cultures several days after the samples were obtained. Analysis and calculation of results of a complete series done by the California State Department of Public Health give a mathematical constant for the death curve. The example of the decrease in Escherichia coli in stored sea water at room temperature is shown in the two following cultures made at stations 8 and 10:

Hours:	Immediate	4	8	12	16	20	24	48
Station 8 .	1/500	1/100		1.10		1.		1.
Station 10 .	1/1000	1/500	1/100		1/10		1.	1.

The figures represent the maximum dilution of the sea water in which Escherichia coli was isolated.

In spite of this bacteriological action of the sea water, Escherichia coli was frequently found in excess of 110 per cc. in the surf nine miles from the outfall. Careful study of the polluted surf indicated that most of the sewage bacteria were transported in very fine particles of tissue or fuzz-like



Top—View of the beach at Station 10 on the day after sewage had been by-passed. Note large pale grease pellets, feces, matches, and other debris. *Bottom*—Closeup of sewage grease, referred to in text as Figure 9.

debris. This possibly accounts for the longer survival of the sewage bacteria in the sea water.

Epidemiology

Thousands of people use these beaches every month. There are some swimmers practically every day of the year who are subjecting themselves to the dangers of a serious intestinal disease by bathing in this water. The problem of epidemiologically determining the actual source of the cases of typhoid, paratyphoid, dysentery and poliomyelitis in Los Angeles would require a special force of workers and a complete cooperation of all doctors and patients. Various representatives of organizations which have been unsympathetic to expending money toward a new sewage plant and making the beaches safe and more beautiful have used as one of their arguments, the statement that no cases of serious illness have been proven to arise from bathing in polluted surf. However, certain knowledge has been gained as a result of this survey. Three life guards had to leave their jobs because of serious dysentery incapacitating them from one week to a month and a half. In all three instances, the onset of the illness followed shortly upon a rescue in the polluted surf. One of these life guards contracted paratyphoid B. fever. A number of individuals who are frequent users of the beach have given histories of acute diarrhoea after swimming in polluted surf. In these swimmers there was no evidence of food poisoning. Since most of the beach visitors come from miles away, it would be an enormous problem to try to follow them up and contact them in case of illness.

A heavy pollution of beach at Station S. Edge of wave mark shows row of grease close to feet of bathers.

The photographs illustrate the condition of the beaches. Sewage grease is of nearly the same color as the sand. Visitors carefully avoid the black tar, and unwittingly walk and sit on wave rows of sewage grease. Later they are puzzled as to how they became so dirty and greasy.

Reports from doctors in the Santa Monica Bay cities and the morbidity record of Los Angeles city indicates that there is a high degree of danger from intestinal disease to those who swim in the polluted surf. The doctors along the bay claim that they are kept busy with cases of dysentery, the numbers being in proportion to the numbers of swimmers. The incidence of bacillary dysentery, paratyphoid fever, poliomyelitis, is higher in Los Angeles than elsewhere in the state in proportion to population. Authorities have suggested that since poliomyelitis virus survives in sewage it may be transported by flies, and therefore by the same hypothesis it may be contacted by swimmers in a polluted surf. Fortunately there have been no epidemics of typhoid fever or other intestinal diseases in Los Angeles in many years. But should such epidemics occur the organisms from many of these cases would be swept to the beaches and serve as a constant pool of reinfection for the population of this area.

MEMBERS RESIGNED

The following note was received from Morris Ellinger, formerly of Lake Arrowhead, and a member of long standing in our Association:

> "After a number of years of pleasant membership in the Association I want you to cross my name off the list. I am now at the above address (4545 Wabash Ave., St. Louis, Missouri), and not connected with water and sewage purification. However, I will never forget the interesting meetings with the C.S.W.A. Best wishes to the Association.—Morris Ellinger."

Albert J. Castro, former chief operator of the Santa Clara Sewage Treatment Plant and director of our Association for the past two years, has recently turned in his resignation due to his full-time program as a graduate student at Stanford University under an Abbot Scholarship. Mr. Castro writes:

> "Enclosed you will find the questionnaire you sent me; this may be considered my last act as a member of the Board of Directors. I find I am so busy attending school that I will probably not be able to attend meetings . Therefore I hereby wish to submit my resignation as a Director and member of the California Sewage Works Association."

Ralph W. O'Neill, superintendent of the water and sewage works for Basic Magnesium, sends his kindest regards to his friends in the Association, saying that he doesn't get to see many of the members any more. Mr. O'Neill states that they have a nice opportunity for research, and may have some interesting information in another year. James H. Keller is Chief Chemist and Bacteriologist for both the water and sewage plants, and is a new member of our association.

PROTECTION OF SEWAGE WORKS IN WAR TIME

Discussion led by

P. A. SANITARY ENGINEER WILLIAM T. INGRAM*

MR. INGRAM: I consider it very much of a privilege to be here today to act as a leader in what I feel to be one of the most important discussions to be held at this series of meetings.

I believe we should think of the discussion we are having today as being a discussion of the war-time activities of sewage works men. There are two phases we can consider in dealing with war activities; one is the broad phase dealing with planning normal procedure, normal operation, possible war construction and things of that sort. We have been discussing those during this meeting. They constitute the broad field we are carrying on under normal conditions. There is another, at this time more important, part of the program to be considered: that of specific activities and their relation to the war. We are in a paradoxical situation. We are being asked to assume more responsibility and, at the same time, being curtailed in personnel due to the war. We are afraid, perhaps, to do too much because we may spread ourselves too thin. But we must also evaluate the harm that may be done if we don't do the work that is necessary. With that as foreword, I would like to proceed with a few preliminary remarks which may serve to guide the discussion.

As you all know, the literature concerning sewerage works protetction is incomplete at the present time. There are many articles in connection with civilian defense work, but sewerage seems to be among the lesser subjects mentioned. We all know the weak link is the one that will break, and if sewerage is the weak link and it breaks, all of the work otherwise applied is of less value.

You are familiar with the organization of the state and local defense councils. There is an operating organization (of a local citizens defense corps) in almost every city. It is observed from our work with the citizens defense corps, that there is an interest in sewerage. This interest is reflected in the departments of the cities through the public works, the utilities, fire, police and public health departments, the city engineering staff, and the various private utility companies. Through this group of departments we get the work done, or hope we get the work done. That is the ultimate aim of our effort.

In order to orient this discussion, I have outlined briefly a number of points which I considered important and which require some consideration and thought. Therefore in order to orient our effort we should divide our thoughts in terms of before the emergency, during the emergency, and after the emergency—and work from those captions through the details.

Before the Emergency: It is rather hard to set a dividing line of thought under this caption. I am going to call on many of you here to discuss as many of these points as you feel you would like to in order that we may have the sense of this group as to what is being done at this time in

*U. S. Public Health Service, Assigned to 9th Regional Office of Civilian Defense.

the sewage works field. It must be realized that many of the points are continuing and may be logically included under any or all of the captions.

1. We have first and perhaps fundamentally, a basic study of the treatment works. One of the primary concepts we need to work on in consideration of this particular item is that we can anticipate illogical behavior. We don't know what the civilian population is going to do when we have an emergency. We can only guess; but our guessing should be intelligent—based on probabilities and experience. We need maps of sewers, and areas of critical use in order to know their location and relationship with other activities concerned with the war effort. Concentrations of industry and population may affect the sewerage system.

2. We need to know something of the security of our system and treatment works. Protection against sabotage is not easy. I would suggest that each one of you pretend you are the saboteur—that you are going to sabotage your system and treatment works. Apply that plan and you will be doing what the saboteur plans to do. He is intelligent and knows what he is doing. He will do probably the very thing you figure out, and possibly a little more. Put yourself in that position first, then come back to your present position and say "I am going to protect against that plan of sabotage as far as I am able to, if the structure is worth protecting."

3. We need to protect against physical damage such as fragmentation and blast. Evaluate your structure piece by piece. If any part of it can be eliminated without impairment of the operation of your works, then you need not worry about that part, but if any part is vital to your system, you do need to worry.

4. Anticipate heavier loads on the system because of war activities. Either volume or strength, or both, are likely to be increased. We need to think of the possible damage caused by stream pollution, the health hazards, and any other dangers attendant upon the expansion of a municipality and its functions in the sewerage field, due to increased population and increased industrial activity. Such increases bring problems which we haven't had to face before on the same scale. These are not normal problems. The improvements may be urgent. The question of how money, materials, supplies and labor may be made available to make necessary changes, requires some very intelligent thought.

5. We need to know that the personnel that is working on the sewerage system can be trusted. One individual can do a tremendous amount of damage if he is allowed to do what he would like to do if he is in the employ of the enemy. You need to identify your men that are doing responsible jobs so others may know they have the right to do what they are doing.

6. Prepare to train personnel. We must be prepared for possibility of situations arising when regular employees enter the service and new, inexperienced men come in. Accident hazards are increased and damage to the system may be caused by new employees. In many small cities, if the operator should be injured during a bombing incident, there would be no one there to take his place. We should have relief operators and auxiliary men who are well enough trained to step in in event of necessity. These may be volunteers or perhaps part-time employees.

7. Administrative organization is one of the most important things in

the whole war effort as I see it. There needs to be coordination between all departments and all services of the cities' defense forces. Such coordination must be worked out, with every man working on it, if the civilian army is to function at the time it is needed.

We must utilize the manpower on the basis of maximum efficiency. Avoid duplication of work and dual responsibilities. Recently I had occasion to discuss the latter point with a superintendent of a water plant who had been assigned to an air-raid listening post. Now is the time to correct such inconsistencies in the defense plan.

8. Financial and legal problems are multiplied under war conditions. It becomes necessary in the interest of speed to sacrifice many rights and privileges which are proper and justified in normal procedures. Some of the legal and financial difficulties can be anticipated if careful attention is given to defense planning. There will be no time for discussing technicalities while bombs are falling.

The Emergency Period: 1. How and when will repairs be made? Are they going to be made after or during the damage? Should they be temporary or permanent? Repair crews should know their work, so that maximum repairs can be made in minimum time. There has been a little experience in California on the type of thing that can be very real to all of us. You all remember the recent floods when the sewerage piping system of San Bernardino was torn out of the river bed and for a number of days the sewage was carried down the side of the street in a ditch. Until that ditch was constructed the sewage was running all over the pavement. We have to draw on those experiences we know about, and allow our imagination to go ahead from there and think of all the damage that may be caused. In England it has been suggested that if one thinks of the damage that can be caused, multiply by two and add a safety factor, one may be approximating the damage that may be caused in the actual disaster.

2. We have to operate the system as well as repair it. Increased water use for fires, and tremendous amounts of water for decontamination service may be expected. Decontamination water is as dangerous as the original vesicant gas in many instances. Broken water pipes will contribute water to a combined system or storm drain. Do we have bypasses that can be operated if necessary?

Are we going to have stoppages in the sewer system which will cause backing up of sanitary sewage into basements or houses or in the streets? If sanitary sewage or polluted water gets out of bounds who is to be notified? The Health Department has a real interest in protecting the health of the people at all times. Notification of health authorities or cooperation therewith is a necessity in time of emergency.

3. We need to think of the use of the sewage laboratory in a little different terminology than we do ordinarily. Can it be used by other agencies?

4. During emergencies we have community sanitation to worry about. In congested areas it is necessary perhaps to build public latrines to provide places in the streets or in the neighboring parks or wherever there may be open ground, to keep the community reasonably sanitary during emergencies when water and sewer lines are broken and normal functions cannot go on.

5. We need to think of the possibility of interchange of equipment, materials, and personnel—when and where needed. Perhaps the bombing incident is of such magnitude that the local crews cannot handle it. Then we like to feel we can call on our neighbors to help us take care of that situation.

After the Emergency: 1. There are going to be a tremendous number of financial and legal problems develop. They should have been considered as much as possible ahead of time, but naturally some will have been overlooked. As much as possible should be accomplished between the first and second incidents, to smooth the way for more efficient procedure.

2. We should analyze the shortcomings of our plans. We shouldn't say everything is perfect. We can't possibly plan every detail of an emergency; there are bound to be some things left out. But we can apply a critique to the damage and to the plan of operation and the next incident will find us better prepared.

3. Last but not least, is the task of reconstruction. This will have to be accomplished with whatever materials are available and may require many substitutes. Ingenuity will be required to complete the work.

I would now like to call on a few of those present who have been working on this problem of protection of sewage works in war time. I would like first Mr. Kennedy and then Mr. Randall to discuss this from the viewpoint of the City of Long Beach.

MR. KENNEDY (City of Long Beach): The matter of civilian defense has been given most serious consideration in Long Beach, probably intensified by the experience of some ten years ago. Following the earthquake an organization was set up which continued as such until the present Council of Defense was authorized, when it was a comparatively simple matter to switch the original set-up over to the present plan.

The matter of protection against sabotage for war emergency involving damage to sewers and pumping stations, et cetera, had not been seriously considered before Captain Ingram visited in our city a short time ago, and following Captain Ingram's suggestion, we are making a survey intended to locate and protect those points of the lateral sewer outfall system and pumping stations which may be considered as vulnerable in the event of a raid. Also, it is proposed to seal, or otherwise protect manholes against opening by unauthorized persons. The necessity of such protection was brought very forcibly to our attention a month or so ago, when one of our pumping stations was completely disrupted—whether by accident or sabotage is not yet known.

So far as general repairs are concerned, I will leave that matter to my associate, Mr. Randall, who, as a member of the Defense Council, is more familiar with the plans covering activities of the Public Service Department.

However, from an actual standpoint, and to care for emergency calls, our unit has set up a plan and has organized, in addition to the regular crews, several emergency crews made up largely of city employees whose duty it is to move on the "Blue" and to report to their respective headquarters, which are located at strategic points throughout the city. These crews will be used in any emergency and, though a part of the Demolition Unit, will not function in other than emergency work.

Other crews made up of volunteers and led by men who are well qualified to carry on, have been organized. These, also, are to be located at strategic points throughout the city so that in the event of an incident in their locality they will proceed immediately to carry on their work, supplemented, if necessary, by crews from other districts. These crews will report on the "all-clear" signal and are expected to handle all demolition and emergency construction of any nature.

While I hope that we may never be called upon to function in actuality, I would like to report that we are ready.

I will ask Mr. Randall to carry on from here and to give to you an idea of preparations which are being made to cover general repairs.

MR. RANDALL (City of Long Beach): Mr. Chairman, Mr. Kennedy and I came here to listen and not to talk. We had fully hoped that we would learn many things that would aid us in the various troubles we are having in regard to the coordination of our defense effort.

Our biggest trouble has been trying to eliminate duplication of effort. Almost every city in California has a condition which is pretty hard to counteract. In most instances, the power companies have their own trained personnel which they naturally feel are the most competent to make any emergency repairs necessary. In fact, in some instances they refuse to allow any other personnel to "monkey with their stuff."

This same situation applies to other privately-owned utilities. Originally, Long Beach contemplated combination crews, but it was found that the utilities departments and companies did not believe that the combination crews would accomplish the results they hoped to obtain. Frankly, in Long Beach we do not feel that we have the positive answer to this problem yet.

As far as sanitary sewers and storm drains are concerned, the original OCD information that came to us in July, 1941 threw the sewers and storm drains into the utilities division of the Defense Council. As you know, in almost every city the sewage disposal, as well as the storm drain system, is a part of the engineering department or the department of public works. The information we received about the first of 1942 indicated that the sanitary sewer and storm drain system should be a part of the public works division. The most recent information we have received indicates that they should be back in the utilities division. While it is realized that the information which is received from the OCD is intended only as a guide, frankly we still do not know where the OCD feels is the best place for emergency work on these facilities.

Due to the fact that we were unable to create these fairly large emergency combination crews which might handle problems occurring on all types of utilities, our emergency set-up has eliminated the use of such a crew, leaving the matter entirely to the utilities company involved and making it their problem and responsibility to repair any damage occurring to their own facilities. We have, however, included what we consider to be a "flying squadron" for more or less first-aid work or reconnaissance in the area. They would only be able to accomplish temporary repairs in order that the situation could be controlled. Following this type of emergency

service, it is intended that these crews revert strictly to demolition and emergency construction units.

Nothing which has been stated or explained above is intended to convey the impression that the fullest spirit of cooperation between any of the utilities departments or companies has been lacking. In fact, the reverse is true.

MR. RAWN (Los Angeles County Sanitation Districts): Mr. Randall has asked how to iron out some of the duplication stumbling blocks in civilian defense work. There won't be any real answer to this until, in my opinion, we get into the thick of a situation which will call for great effort on the part of those engaged in civilian defense. In the meantime it seems basic to me that our forces of the civilian defense organization must carefully plan and chart their position in the whole picture; know pretty well what moves to make, the source of their information, the sequence of events essential to sewerage maintenance and repair following sabotage or bombing, and then proceed in straight lines as far as possible to do the job efficiently and well without particular reference to the multitude of activities which will be going on about us. This does not imply a lack of cooperation; certainly it will be necessary to plan procedure in such a manner that a minimum of interference with the functions and duties of other agencies will be had. The thing I am trying to imply here is that the doing of the job when the time becomes critical is the basic thing and those charged with the responsibility of sewerage works know far better than any one else what to do and how to do it in connection with their own line of endeavor.

I would like to picture for you what occurs to me as a possible happening in sewer maintenance in this area following a bombing. In the first place, there is probably no place in the world where the area's economy is so thoroughly connected with petroleum products development as here in Southern California. The metropolitan district is thickly underlain with a vast number of pipe lines carrying petroleum products ranging from crude oil to the most volatile type of casing head gasoline. I am aware of certain intersections in the area where not less than thirty (30) pipe lines criss-cross—most of them carrying petroleum oils and gasoline. It is conceivable that if an area is bombed and the utilities in the street disturbed, that the sewer will have flowing in it a large quantity of gasoline or oil. It is also very likely that incendiary bombs or explosives will be used at the same time, so that the oils and gasolines will be ignited. This is not a far-fetched visualization of what may transpire, because during the earthquake of 1933 lines conveying casing head gasoline were ruptured at or near the trunk sewers of the County sanitation districts, and inspection the following morning disclosed that not less than 12 miles of large diameter sewers were filled with the gasoline fumes. Gasoline was being pumped from the sewer into the treatment plant and the whole lower end of the system was a potential bomb. Venting this gasoline from the line was quite a problem. It was accomplished safely, but had there been any fire in or near the sewer at the time the results would have been appalling. It isn't necessary for the sewer lines to be broken to admit casing head gasoline. I have seen the flow from a broken pipe line seep through the soil and pass into a sewer through the brick manhole walls in sufficient quantity to completely destroy

the sewer were fire applied to the explosive mixtures.

There is one thing that the sewerage authorities may anticipate with complete confidence, and that is that whenever disaster overtakes anything that has a connection with the sewerage system, and there is something which needs to be gotten rid of, it will be emptied in the sewer—and it won't make any difference what it is, just so it will flow. In time of disaster we must be prepared to flood our lines first to put out fires and then protect ourselves and our treatment works afterwards.

MR. CORTELYOU (City of Los Angeles): The subject is one of very great interest to all of us, and involves a great responsibility.

As to the conflict or disorganization which has been said to exist in the matter of handling repairs to sewers or storm drains by the speaker from a nearby city, in thinking of our own setup in Los Angeles, I do not believe there is such a condition. I believe our basic plans of operation do not involve conflict of authority or any lack of organization. As to whether or not sewers and their repairs should be handled by the utilities, as is mentioned in the O.C.D. instructions on public works, it is a matter of no great concern as far as the Government is concerned. The purpose is to have the matter attended to appropriately. I understand that the O.C.D. is not greatly concerned with observation of their manual to the exact letter, but wish to be sure an organization is set up which will perform the function. In Los Angeles the public utilities division of the Citizens Defense Corps does not handle anything but public utilities such as water, gas, electricity, telephones, ammonia lines, etc., and does not handle sewers or storm drains. The repairs to the latter are a function of the public works division, and it is planned to use, and we are organized to use, our regular employees and equipment, with the addition, as may be required, of volunteer labor from the A. F. of L. and C.I.O., and also that of various contractors. I do not anticipate confusion or duplication of effort in Los Angeles.

Like every other city, we have been greatly concerned since Pearl Harbor as to possible sabotage or air raid damage to our sewerage system. One of the great problems in repairing damage to sewers is the matter of by-passing the flow so repairs can be made. We have been concerned for a number of years with the matter of constructing by-passes for repairs or earthquake, but when the war came along we made a critical examination again and found our available by-passes pitifully inadequate. We have therefore undertaken a campaign of construction of by-passes. We pointed out several locations to the Bureau of Engineering and recommended that plans be prepared, and that the Council be asked to appropriate money for construction by contract. Also, we set up tactical problems ahead of time as to exactly what we would do under certain emergencies, and our sewer maintenance division has studied them and prepared solutions, somewhat as a military organization would work out their problems in advance. We assumed that the outfall sewer would be bombed, made plans and a bill of materials of what would be needed and where to get the materials for reconstruction, and handled it clear through to complete reconstruction.

One problem in Los Angeles, where the water supply may be exceedingly limited in fire fighting, is to give assistance to the Fire Department in the matter of water supply. Several lakes in parks have outlets through

storm drain systems for purposes of draining those lakes. These have all been noted with our Fire Department and studies made so this water may be used in case of failure of the regular supply. In this connection we have also worked with the Fire Department, giving them maps of our main trunk sewers, so that sewage may also be used in great emergency by means of dams at the outlets at manholes and putting the pump suction at about half way between the top of the impounded sewage and the bottom of the manhole.

Another problem is the possibility of use of sewers or storm drains by saboteurs to damage defense industry plants. Within the boundaries of Los Angeles there are many defense plants critical to the war effort. We have studied that problem, and Captain Ingram has worked with us, giving us the benefit of his advice.

We have 3000 miles of sewers, 800 miles of storm drain, and about 60,000 manholes, which creates an enormous problem of protection. We have therefore had to take some practical approach to the problem so that we might at least be within the bounds of reason. We have reached the tentative determination that it is not probable, in most cases, that saboteurs would attempt to use sanitary sewerage systems for damaging plants. The sewers are generally full of flowing liquid, and the space above is filled with gas. This, combined with the high velocity of the sewage, makes it seem very improbable that a saboteur would attempt to enter a sewer. We have, however, considered that saboteurs might be tempted to use storm drains. We are making a careful study of 24-inch or larger storm drains, and through cooperation with the local Army officers, are making a study of those lines in relation to defense plants. The question is: how close should a storm drain be to a defense plant before it might conceivably be used for entering and firing some high explosives? We have taken a figure of 50 feet from the storm drain to the wall of the actual building as a reasonable limit. Then, how far up or down stream along that line should we attempt to protect it? What protection could be given? We are planning to provide protection by sealing manhole covers. The question has been raised as to the various methods of sealing those covers to prevent access. Welding has been suggested, but we understand that has not been found very successful in San Francisco. Bolting is another possibility, but nuts must be left exposed on top, and a saboteur may easily remove those in a reasonably short time. We have given consideration to the method used by us in silencing "noisy" covers by sealing them with asphaltic concrete of low penetration, about 30-40 or 40-50, which would be poured hot. It does make a manhole cover difficult to remove—practically requires a blow torch to heat it. We are also experimenting with cement grout, but this does not appear promising.

In this connection I might say we have requested our Police Department to warn all of their patrol cars to be on the lookout for persons who may be attempting to enter the manholes within the streets. They have issued orders to all officers to be on the alert and demand proper identification from any persons seen tampering with manhole covers.

MR. FRICKSTAD (City of Oakland): What I might say would closely parallel Mr. Cortelyou's remarks. We are making the same study

he is making. Los Angeles has many large sewers and numerous culverts carrying creeks under the streets. We have precisely the same types of structures and thus our problem is the same as that of Los Angeles, although of lesser magnitude.

The subject of possible destruction of sanitary sewer raises some embarrassing questions: If such destruction should take place at an important intersection or under a railroad, it would be impossible to open a temporary channel and at the same time keep open lines of communication. We have not given much attention to this as yet, although I think it is one of the most likely things that might happen.

As to closing manholes against saboteurs in critical areas, that seems to be a puzzling problem. We have tried various recommended schemes of grouting with cement and with sulphur-silica compound and they do not create any obstruction to anyone who wants to enter. In test cases grouting delayed our crew not more than a minute. We have a large sewer passing through a shipyard. In that case the length of large sewer outside the yard is relatively short with only a half dozen manholes on it. We are planning to cast a layer of concrete inside the manholes under the covers, leaving a 6″ opening for inspection purposes. That means a compressor will be required to open the manhole for any purpose whatever, which would be a difficult and noisy operation for a saboteur. It will also involve considerable inconvenience if our own crew must enter the sewer, but we do not regard this seriously as to this small group of manholes, inasmuch as we may not have to open more than one or two in a year. We have found no other practical method by which unwelcome visitors may be kept out and at the same time our own men may have reasonable access to the manholes, and therefore for the present will limit this type of activity to the most critical areas.

MR. FRANK ROSSI (City of Modesto): The gentlemen preceding me covered this field very thoroughly. It is true there are yet a considerable number of problems to be ironed out concerning protection of sewerage and water systems. My problem is primarily water supply at the present time. However, it has certain problems in common with the sewerage systems, such as pumping plants, pipe lines, etc. I perhaps should give you a little better idea of the organization that we are setting up in Modesto at the present time, and not particularly the zones covered by the State subcommittee on water supply.

The problems are somewhat different in your coastal area than in our inland cities. We are more interested in the possibility of damage from saboteurs than we are from direct or ærial bombing. We may only be confronted with one attack rather than a series of attacks. What we are doing may be of some value to you gentlemen. All of our cities are not operated on the same principle. That is one of the things we must consider when formulating an organization to protect our utilities, as the authority of the departments is varied. I will try to give you a brief outline of our procedure in organization: There is a considerable overlap of authority in these organizations. We find it to be true especially when men appointed to the various units are sometimes appointed on as many as five or six committees outside of our regular organization. Normally they should be where they

are employed. You have to have all of the departments of the city coordinated properly to get the best results. We have started to organize the entire city.

Modesto is the county seat of Stanislaus County. It has been combined with the Stanislaus County civilian defense control station. Many of the City department heads direct their operations from the control station. This simplifies the procedure. First the air-raid warden reports the cause of damage to the telephone operators at the control station; messengers transmit it to the dispatchers who relay it to public works, utilities, fire or police departments. The units we are particularly interested in protecting are the water and sewerage systems. Our orders come under the public works dispatcher, and he transmits them to the city utility control center; they are then out of the hands of the civilian defense authorities. We have one unit organized into sanitary and laboratory control, headed by the health department inspector. The water system is broken down into three units: one unit for pumping plants, one for large repair jobs, and one for services of a small nature. The repair shops are equipped with all types of machinery and operated by city mechanics. That group may be called for through the public works city control center. Our sewer system and street department have been combined as one unit and operate under the street department. They are organized with their crews, cleaning rods, compressors and other equipment for proper control in case of emergency.

We are having the same problem with storm sewer manhole covers that many other cities are experiencing. Sanitary pumping and water units are being guarded by constant and regular inspections as a prevention against sabotage.

The problem we had in coordinating all these different men and departments was not easy. We have accomplished our goal by calling in the department heads and familiarizing them with the procedure. We discussed the problem as to when the guards should report at the pumping plants. After some discussion it was determined that, perhaps due to the trouble in traveling during a blackout, they should be called to their posts on the first, the "yellow" alert. They should go to their stations and remain there until given the "all clear" signal. This will be rather hard on the guards. It won't be pleasant, for there may be many times they will report to their stations and nothing further will happen. But this is war! We are all conscious of the fact that we'll have to make sacrifices. When it does happen we'll be ready.

MR. HOSKINSON (City of Sacramento): Protective procedure at Sacramento has included closing of all plants to visitors and placing water plants under armed guard, using time-check on their patrol and requiring regular calls to a central point as a further check on their movements. Provision is made for an investigation by police squad car in event regular reports are not received at the central point. Sewage pumping plants are kept locked at all times, and at one station which is isolated, windows and doors are heavily screened and barred. Protective lighting up to limits allowed, and in accordance with coast dim-out regulations is provided at all plants. Procedure for sealing vital manholes has been started along the lines of suggestions received through Major Arnold's office. Trials have been made of

manhole sealing by use of lead-sulphur compounds and cement grout. We have also heard that sealing by hot lead is very effective. Present experience has not developed the best manhole seal.

Water and sewer departments cooperate in the weekly drills on test incidents sending both water and sewer trucks to locations of incidents where such service is indicated. The local Master Plumbers Association and Plumbers Local Union have volunteered their help for emergencies and cooperate in defense drills. In case of bombing or special call, plumbers report at five (5) separate strategically located assembly points from which they move to incident locations as ordered or await pickup by city truck. Equipment of the Master Plumbers Association has been listed with the city for use in emergency. All local unions show a good spirit of cooperation in the city defense effort.

MR. MANCINI (Vice-President, Public Works Officers): I am afraid I have nothing to add. I think the ground has been pretty thoroughly covered. I believe it is true a great many of us have overlooked the importance of safeguarding the sewerage systems.

MR. MAY (City of Palo Alto): Before we started this discussion today I did not think there was much of a sewer problem. We are a small community and we do not have any nearby defense industries. The only possibility of attack probably would come from a stray bomb. We never considered the sewers. We thought if the plant were damaged we could make a ditch and drain the sewers into the natural channel. But today I can see it is not as simple as that at all. When I get back I think we will follow your outline and see what we can do.

MR. GOUDEY (Los Angeles City Water Department): I happen to be on the national committee of the Sewage Works Association. The final report of that committee will come out about a month from now. I don't believe most of us receive seriously enough the advice that was given us in the opening part of this paper. We have lost a lot of our personnel, and going to lose more. I don't believe one-third the people here, who are going to be in the services a year from now, took that to heart. It is a serious situation. It is our responsibility to see to it that the duties of the sewage plants operators are outlined so that adequate help can be obtained. The industries have ordered their personnel sections to find out what jobs in their particular industries can be turned over to women. The water departments have made surveys to find out what jobs can be turned over to women. Power departments are doing the same thing, even as it applies to linemen, power poles, etc. Women are going to operate water pumping plants. I'm not talking through my hat—I'm telling you what representatives from Washington are telling critical industries and utilities. So why shouldn't the Sewage Works Associations figure out what jobs in the matter of sanitation and sewage disposal can be turned over to women? Obviously we won't say they should do the actual repair work. You need a woman who has a list of the names of plumbers; who is familiar with the plans of the sewer system, and who can operate sewage pumping plants. Women can be used in the operation of sewerage works, whether on a volunteer or paid basis. If the war keeps up you will find out this statement means something that we should seriously consider.

Operators should be studying the change in the character of sewage due to wastes from war industries and particularly from chromium plating plants. Sewage can become toxic from chromium. England has found a number of high-grade treatment plants completely upset by the toxic chromium wastes contributed to the sewage. Perhaps you don't know you have a plating plant in your town. It should bear investigation.

At the Santa Cruz convention I outlined a number of tests which the sewage treatment plant operators could make to determine poisons and war gases in sewage. That paper was not well received because it was given before Pearl Harbor. After Pearl Harbor a number of the members said I was perhaps right. I still say the sewage plant operators should make those simple key tests which were recommended in that paper. They are still standard and still tell us the group war gases. Each operator should know at least how to make those tests should such an occasion arise.

I think the time has come when sewage treatment plant operators should clearly keep in mind what degree of treatment is absolutely essential from a health standpoint, as contrasted with more complete treatment during peace time. When the times get tough it might be necessary to disregard any repairs to that part of the plant which does not need to operate from the health standpoint. The operator should know the minimum degree of treatment to protect health and safety and not expend large sums of money to restore for peace time treatment during war.

If our large reservoirs become contaminated by gases they will be dumped into storm drains and sewers. War gases in general are toxic and will tend to destroy biological processes at treatment works. If we are going to protect ourselves from all these angles, it becomes a man-sized job. I think we should be prepared. It will take much time, thought, energy—but very little money.

MR. KENNEDY (San Francisco): I think it is important that the public be informed on problems of sewage treatment and their relationship to public health under emergency conditions as differing from normal conditions. Under conditions of disaster sewage may be turned into open ditches or street gutters. The public will have to be informed of the sanitary significance of sewage so discharged. The principal problem to be met in sewage treatment is the unanticipated load from industrial plants which have been established under the war emergency. One of these in my experience has requested plant service for wastes containing a high chlorine residual. It was recommended that this waste be turned into a storm drain since it has no health significance. Wastes that are toxic must be diverted from treatment plants, and people will have to be made aware of the fact that such diversion is necessary. In the design and operation of sewage works for emergency conditions we must distinguish between the things that have definite health significance and those which are desirable under normal conditions. Those wastes which are not of themselves dangerous to health may be diverted to storm drains or natural channels with only the creation of local nuisance.

SHORE POLLUTION REDUCTION AT SAN FRANCISCO

By **CHARLES GILMAN HYDE***

Foreword — Sewerage improvements, including sewage treatment and disposal, are presumably undertaken with the expectation that some definite benefit will accrue. Without such a salutary result the effort and expenditure involved would not only be meaningless but would represent a positive loss. Fortunately, in most instances, the benefits are positive, although perhaps incapable of being calculated in money terms. Rather are they to be reckoned in terms of greater hygienic safety, or a cleaner environment, or both.

It is wise for any community which has made its investment in improved sewerage, and undertaken to meet the annual costs of the thereby increased obligations, to review the results from time to time and determine what advantages have been secured and what sort of a dividend is being obtained. This paper attempts to indicate the sewerage improvements which have recently been made in San Francisco, to state the immediate purpose thereof, and to show what results have been achieved.

This writer has been able to discover little or no positive evidence that typhoid fever or other water-borne diseases, or ill health in general, have followed the use of sewage-polluted water for swimming or other recreational purposes. That the theoretic possibility exists must be conceded. It probably is in the public interest to assume that danger lurks in such practices.

Quite aside from such considerations, a clean environment is worth having for its own sake. There is no cleaner large group of people in the world than that resident in the United States. Enormous amounts of money are spent annually by Americans on soap for laundry and bath, and on the dry cleaning and pressing of wearing appareal. People who are willing to spend such enormous sums for personal cleanliness and appearance are, or should be, willing to spend the amounts necessary to provide for that degree of environmental cleanness which is obtainable through adequate sewerage and rational sewage treatment.

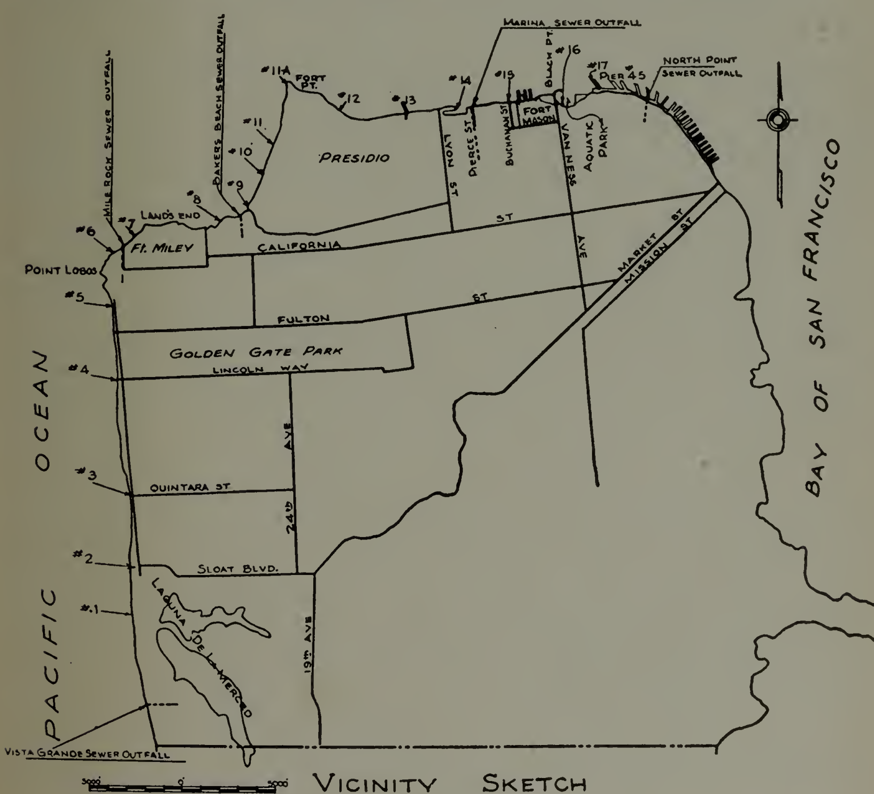
History of Sewage Conditions and Improvements— From the beginning of sewerage in San Francisco the sewage has been disposed of by dilution in Pacific Ocean, Golden Gate Strait and San Francisco Bay. Prior to 1899 when C. E. Grunsky, as City Engineer, made his justly famous study and report on sewage conditions, with recommendations as to improved sewerage (1), the sewers generally had been built in haphazard fashion and carried to the most convenient points of outfall regardless of esthetic or sanitary considerations. It has been stated that there were some 125 separate sewer outlets at that time (2). Under the Grunsky plan the sewage of the city was to be concentrated at six main outfalls located between China Point, at the extreme southeast city limit on San Francisco Bay, and Mile Rock, at the extreme northwesterly limit of the city near Point Lobos. Point Lobos may, perhaps, be considered as the place of demarcation between Pacific Ocean and Golden Gate Strait.

The Grunsky report served to call the attention of the citizens to the

*Consulting Sanitary Engineer, Department of Public Health, San Francisco.

gross mistakes and inadequacies of the existing sewerage systems, if indeed they could be called systems. It also served as a guide to new construction and the rehabilitation and reconstruction of the older sewers.

During the 20-year period ending in 1935 approximately $17,500,000 was expended on the construction of new sewers and the replacement and extension of old sewers (2). None of this money was expended for sewage treatment. Shore conditions were, however, improved by the elimination of numerous outfalls. The situation at Bakers Beach was temporarily bettered by conveying the sewage concentrated at this point to deep water through an 18-inch cast-iron outfall 800 feet long. Unfortunately this pipe line developed a number of breaks which essentially destroyed its utility.



Sketch map of San Francisco showing boundary waters and locations of sampling stations. (From *Sewage Works Journal*, Vol. XI, No. 5, Sept. 1939, pp. 815.)

In 1928 the City Engineer, John J. Casey, reported that a program designed to satisfy only the more pressing needs of the sewerage system with respect to the extension of necessary main sewers, and the replacement of obsolete existing sewers, would entail an expenditure of not less than $13,-000,000.

At that date many of the existing sewers were still inadequate, many were in a deplorable physical condition, and the separation of sanitary sewage from storm drainage was greatly needed in certain sections of the city. That situation still obtains.

On November 7, 1933, the citizens voted P.W.A. sewer bonds in the sum of $2,625,000 to provide certain essential sewerage improvements and a limited amount of sewerage treatment. The sum nominally available for the latter undertaking, including the elimination of certain outfalls by pumping the sewage to other points, was $1,300,000. The actual sum finally expended was approximately $1,580,000.

Under a Department of Public Works order, approved July 25, 1934, a board of consulting engineers was appointed to determine and recommend the most suitable program of sewerage improvements and sewage treatment which would restore the beaches and coastal waters to a safe and attractive condition. This board, consisting of the late Harrison P. Eddy, Charles G. Hyde, Clyde C. Kennedy and Leon B. Reynolds, rendered its report in May, 1935 (3). Its work was ably assisted by the City Engineer, John J. Casey, by W. H. Ohmen, Chief of Design, and by Benjamin Benas, Sanitary Engineer.

The Board reported that the sewage of the city was being discharged from six sewerage districts with many points of outfall. As a matter of fact, there were 31 outlets discharging sewerage at the shore line or into small estuaries and channels. The latter were located along the east shore on San Francisco Bay. Of the 31 outfalls, there were 19 along the Bay shore, 11 along the north shore on Golden Gate Strait, and but one on the west coast, Pacific Ocean. This was located at the extreme southwesterly corner of the city's incorporated area, later herein referred to as the Vista Grande outfall.

The Board of Consulting Engineers recommended a program of sewage treatment and disposal which, if adopted, would reduce the number of outlets to four and would provide adequate treatment at each of these locations. The four selected outfall and treatment sites were as follows: (*a*) a treatment plant in Golden Gate Park with discharge through the existing Mile Rock outfall; (*b*) a treatment plant in the vicinity of Piers 37 and 39, with discharge into San Francisco Bay through a submerged outfall with terminal diffuser-nozzle field in 60 feet of water 2000 feet off shore; (*c*) a treatment plant at Hunter's Point with deep outfall off shore; (*d*) a treatment plant and off-shore outfall at Visitacion Valley (China Point). The Board advanced the conclusion that, with the completion of the recommended works and their faithful and efficient operation, the sewage of the city would be disposed of in as effective and economical manner as possible having due regard for the suitable protection of the beaches and shore waters from sewage pollution.

In view of the fact that the nominal sum of $1,300,000 was then available for sewage treatment, or its equivalent in terms of removal from shores which were in immediate need of pollution abatement, the Board recommended that the money be expended for pumping the sewage of the Marina district eastward to a point of discharge in the slip between Piers 37 and 39 at North Point, so called, and that all of the sewage of the Bakers Beach, Richmond and Sunset districts, comprising nearly all of the northwesterly

and westerly portion of the city, be concentrated in the southwesterly corner of Golden Gate Park, there be treated suitably, and the effluent be discharged through the existing Mile Rock outfall situated about midway between Point Lobos and Lands End.

As the next step, urgently required but for which no funds were then available, the Board recommended the treatment of the sewage concentrated at North Point and its disposal in San Francisco Bay as indicated above. This project was estimated to cost $2,250,000. Later, but less immediately urgent, the concentration and treatment of the sewage of the southeasterly portion of the City at two locations, as previously described, was recommended.

At that time the sewage of Daly City, Colma and a small section in the extreme southwesterly part of the city, was being discharged directly at the shore line through an outfall known as Vista Grande. This condition still exists and doubtless causes shore pollution through a limited distance northward along the San Francisco coast line. Fortunately, from a sanitary standpoint, this section is restricted as to public use since it forms the western boundary of a military reservation. It is proposed eventually to pump this sewage into mains leading to the Richmond-Sunset sewage treatment plant.

Under the bond issue above mentioned the city has constructed the Marina pumping plant and force main to North Point, the Richmond-Sunset sewage treatment plant (4), (5), (6), and the Sea Cliff pumping station and force main. Sewage from the Bakers Beach district is diverted for the most part by gravity through a tunnel and connecting sewer to the Richmond-Sunset plant. The Sea Cliff pumps discharge into that tunnel the last remaining relatively small volume of sewage which formerly had fouled the shore waters and strand of Bakers Beach.

A sewer bond issue for $5,000,000 was lost at the polls in 1937 and another for $4,200,000 was defeated in 1938.*

Use of Shores and Beaches—San Francisco's shore line has a length of approximately 23 miles. Scattered along this reach are some 16 recreational beaches, large and small. Only two of these are on San Francisco Bay. There are 13 on Golden Gate Strait, east of Point Lobos.

Some of these beaches are relatively large and assessible. One in particular, that extending in an unbroken stretch for five miles southward from the Cliff House, is truly magnificent. In its northerly portion it is flanked by the Esplanade and Great Highway and has become famous as one of the truly great recreational beaches of the world.

These beaches are places of resort on all pleasant days throughout the year, but naturally and more particularly during the warmer season from April to October, a period of seven months.

Because of the low temperature of the water the extent of swimming is relatively small in comparison with that from the beaches of Southern California. However, swimming is indulged in as a sport and is especially favored from the beaches and coves of Golden Gate Strait and San Francisco Bay where the water is somewhat warmer, or is thought to be, the undertow less, and the protection from wind better. Otherwise all of the

*Neither of these issues made provision for sewage treatment at North Point.

beaches are used for wading, fishing, boating, sun bathing and picnicking.

Investigations of Shore Water Conditions—Long before the sewerage improvements herein described were undertaken, it had of course been realized that the shores and shore waters were grossly polluted. This was manifest from the fecal and other sewage matters to be found on the beaches and in the coves and because of the very noticeable sewage fields offshore. These conditions had been so long existent that the citizens had grown complacent about them. Moreover, they had never known anything better.

Realizing that such foul conditions were not in the public interest, Dr. J. C. Geiger, Director of Public Health, determined to attempt to rouse the city from its lethargy in this matter. In 1931 the principal beaches and coves were quarantined against swimming and warning notices were published in the daily papers. This excited some interest but not enough. It was therefore determined: (*a*) to conduct a year's study of the bacterial condition, as related to sewage organisms, *Bact. coli,* of the coastal waters along the west and north shores, where most of the utilized beaches are located, in order to have positive and irrefutable evidence of the nature and degree of pollution; (*b*) to publicize the findings as these accrued.

Under the immediate direction of A. B. Crowley, Chief Inspector, 18 representative sampling stations were carefully selected between the Funston Life Guard Station on Pacific Ocean and Pier 45, east of Fishermans Wharf, at the extreme easterly end of Golden Gate Strait. Shore samples were collected weekly at each station for a period of 52 weeks from February 6, 1933 to February 7, 1934. The results of this survey, which demonstrated gross pollution, particularly along the north shore, were widely heralded and at length succeeded in rousing the citizens to action. The effect was manifest in the ballots cast for the P.W.A. Sewer Bond election of November 7, 1933, above referred to (7) (8).

The Marina pumping plant was completed on May 18, 1937, and went into full and uninterrupted operation on July 1 of that year. The Richmond-Sunset sewage treatment plant was completed on January 30, 1939, began operating on March 1, and went into full and uninterrupted operation on May 1, 1939. The Sea Cliff pumping station began continuous operation on March 16, 1941.

In order to determine the effectiveness of these sewerage improvements, particularly as related to the Pacific Ocean beach, the Department of Public Health inaugurated a series of shore water samplings at five of the 18 stations previously employed in the 1933-34 survey. These were begun on March 5, 1940, and are still being continued. To date, 105 sets of samples have been collected and analyzed in the Health Department's laboratory. Military restricted areas were set up early in the current year which reduced the number of these sampling stations from five to three.

Improvement in Bacteriological and Other Conditions—The present discussion of the specific improvement of shores and shore waters will be restricted to the Pacific Ocean strand. The reason for this lies in two facts. A patent one is that the bacterial sampling of 1940–41–42 has been confined to that stretch of shore line. The second reason, which has also determined the current sampling schedule, is that the proposed North Point treatment

and disposal works are still a matter of future design and construction. The population now sewering to that location is approximately 460,000. This figure does not include the transient population represented by the large registry in hotels nor the important suburban groups employed in the commercial and manufacturing establishments of the district. As already stated, the sewage from this large population is discharged at the shore line and is carried by the tides back and forth along the north shore, probably causing more or less serious pollution as far westerly as Fort Point and the Golden Gate Bridge. Until the sewage treatment and disposal project recommended for this district is carried through, completely satisfactory conditions as related to shore and shore water pollution in the reach under consideration cannot be expected. However, in this connection it truthfully can be stated that the conditions along the north shore as far east as Fort Mason, and including the Marina district, have been vastly improved due to the undertakings above described as having been carried through under the recommendations of the Board of Consulting Engineers in its Report of May, 1935 (3).

The studies of the period February 6, 1933, to February 7, 1934, for the five sampling points along the Pacific Ocean shore from the Funston Life Guard Station on the south to a point near the Cliff House on the north, gave results, as related to the presumptive presence of *Bact. coli,* as shown in Table I.

TABLE I.—*Presumptive Numbers of Bact. coli per Cubic Centimeter in Pacific Ocean Shore Waters, San Francisco, Prior to Recent Improvements in Sewerage and Sewage Disposal*

Representing 52 Weekly Samplings, February 6, 1933, to February 7, 1934. Sampling and Laboratory Analyses by San Francisco Department of Public Health.

No.	Station Location	Numbers of *Bact. coli* per c.c. Average	Maximum	Minimum
1	Funston L. G. Station	9.6	69	0.0
2	Sloat Boulevard	18.1	240	0.0
3	Quintara Street	68.0	2400+	0.1
4	Lincoln Way	102.6	2400+	0.0
5	Balboa Street	128.8	2400+	0.0
All		65.6	2400+	0.0

The studies of the period March 5 1940, to date have shown the presumptive presence of *Bact. coli,* reported as numbers per cubic centimeter, by years and for the entire period, as presented in Table II.

As already indicated the greater use of the beaches and shore waters in the San Francisco area occurs during the warmer dry season, a seven-month period from April to October. For this reason it is of interest to examine the bacterial condition of the Pacific Ocean shore water during that specific period. This has been done and with results which are presented in Table III.

No total counts of bacteria growing on standard agar at 37 degrees C. were made on samples collected during the 1933-34 survey. These determinations have been included in the survey begun in 1940 and now continuing. Although it is recognized that the bacteria in question have little, if any, direct sanitary significance, their absence, or presence in relative small numbers, implies a clear water. On the other hand, if a water contains great numbers

Table II.—*Presumptive Numbers of Bact. coli per Cubic Centimeter in Pacific Ocean Shore Waters, San Francisco, Subsequent to Recent Improvements in Sewerage and Sewage Disposal*

Representing 105 Series of Sampling in 1940, 1941 and 1942. Sampling and Laboratory Analyses by the San Francisco Department of Public Health

Year	*Bact. coli* per c.c.	Stations* 1	2	3	4	5	All
1940	Aver. . .	2.7	1.7	16.5[a]	0.6	2.0	4.7[b]
(43 samplings)	Max. . . .	69.0	24.0	690.0	6.9	69.0	690.0
	Min. . . .	0.0	0.0	0.0	0.0	0.0	0.0
1941	Aver. . .	13.3	6.4	15.5	7.2	20.4[c]	12.6[d]
(45 samplings)	Max. . . .	69.0	69.0	240.0	69.0	690.0	690.0
	Min. . . .	0.0	0.0	0.0	0.0	0.0	0.0
1942	Aver. . .	......	9.7	5.2	......	4.3	5.6
(17 samplings)	Max. . . .	......	69.0	24.0	......	24.0	69.0
	Min. . . .	......	0.2	0.2	......	0.2	0.2
The Period	Aver. . .	8.1	4.9	14.4[e]	4.0	10.3[f]	8.4[g]
(105 samplings)	Max. . . .	69.0	69.0	690.0	69.0	690.0	690.0
	Min. . . .	0.0	0.0	0.0	0.0	0.0	0.0

[a]Average=0.5, omitting a single high count in 43 samples.
[b]Average=1.5, omitting a single high count in 215 samples.
[c]Average=5.2, omitting a single high count in 45 samples.
[d]Average=9.5, omitting a single high count in 225 samples.
[e]Average=7.8, omitting a single high count in 103 samples.
[f]Average=3.7, omitting a single high count in 104 samples.
[g]Average=5.6, omitting two high counts in 487 samples.
*For location of stations see Table I.

of such organisms, the implication may well be that it is at least dirty, speaking bacteriologically; if not actually harmful. As a matter of interest, perhaps academic in this case, Table IV, herewith, has been prepared to present the results of the counts of total 37-degree bacteria in the entire group of samples collected during the period under review and, also, the results of counts on samples collected only during the April-October periods of the three years 1940-42.

Discussion of Bacteriological Findings.—The survey of 1933-34 whose general results are summarized in Table I, was made prior to the sewage and sewage disposal improvement whose benefits, as related to a clean shore water and shore environment, it is the purpose of this paper to explore.

The results of this survey will first be reviewed as a whole. The figures in Table I disclose the general fact that the pollution of the Pacific Ocean shore water, as indicated by the average presumptive numbers of *Bact. coli* per cubic centimeter therein for each of the five sampling stations, was progressively greater accordingly to the proximity of the Mile Rock sewer outfall. While the average condition of the water at the Funston Life Guard Station, Station 1, was within the usually accepted standard for salt water outdoor bathing, this average was very far above that standard at Balboa Street, Station 5, a point about 5,000 feet, by way of the shore line, southwesterly of the Mile Rock outfall.

However, a review of the laboratory findings on each of the samples collected during the survey shows that the increasing averages of *Bact. coli*

TABLE III.—*Presumptive Numbers of Bact. coli per Cubic Centimeter in Pacific Ocean Shore Waters, San Francisco, Subsequent to Recent Improvements in Sewerage and Sewage Disposal*

Representing 76 Series of Samplings During the Seven-Months Periods, April-October of the years 1940, 1941 and 1942. Sampling and Laboratory Analyses by San Francisco Department of Public Health.

Season April-October	*Bact. coli* per c.c.	Stations 1	2	3	4	5	All
1940	Aver. . .	2.9	1.4	0.4	0.3	0.3	1.0
(31 samplings)	Max. . . .	69.0	24.0	2.4	2.4	2.4	69.0
	Min. . . .	0.0	0.0	0.0	0.0	0.0	0.0
1941	Aver. . .	12.5	5.7	16.7	9.0	27.0[a]	14.2[b]
(29 samplings)	Max. . . .	69.0	69.0	240.0	69.0	690.0	690.0
	Min. . . .	0.1	0.0	0.1	0.1	0.1	0.0
1942	Aver. . .	......	8.7	3.9	......	4.1	5.6
(16 samplings)	Max. . . .	......	69.0	24.0	......	24.0	69.0
	Min. . . .	......	0.2	0.2	......	0.2	0.2
3 Seasons	Aver. . .	7.5	4.5	7.4	4.5	11.4[c]	7.2[d]
(76 samplings)	Max. . . .	69.0	69.0	240.0	69.0	690.0	690.0
	Min. . . .	0.0	0.0	0.0	0.0	0.0	0.0

[a]Average—3.3, omitting a single high count in 29 samples.
[b]Average=9.5, omitting a single high count in 145 samples.
[c]Average=2.2, omitting a single high count in 75 samples.
[d]Average=5.2, omitting a single high count in 344 samples

TABLE IV.—*Total Numbers of Bacteria per Cubic Centimeter at 37 Degrees Centigrade in Pacific Ocean Shore Waters, San Francisco, Subsequent to Recent Improvements in Sewerage and Sewage Disposal*

Representing 105 Series of Samplings in the Years 1940, 1941 and 1942 and 76 Series During the Seven-Months Periods, April-October, of Those Years. Sampling and Laboratory Analyses by San Francisco Department of Public Health.

Period	Total Bacteria	Stations 1	2	3	4	5	All
Entire	Aver. .	91	145	1,070[a]	114	189	327[b]
	Max. . .	1,500	5,000	100,000	1,000	5,000	100,000
	Min. . .	1	1	1	1	1	1
7-Mos.	Aver. .	75	156	1,430[c]	77	196	410[d]
	Max. . .	1,500	5,000	100,000	1,000	5,000	100,000
	Min. . .	1	1	1	1	1	1

[a]Average— 96, omitting a single high count in 104 samples.
[b]Average=122, omitting a single high count in 487 samples.
[c]Average= 75, omitting a single high count in 75 samples.
[d]Average=120, omitting a single high count in 344 samples.

numbers, from station 1 to Station 5, was due to a few samples only which showed heavy pollution.

A striking condition, apparently without any obvious explanation, was found to exist during the seven months period, April to October, 1933. During this time no increase was found in the number of *Bact. coli* present in the water as the Mile Rock sewer outfall was approached, with the exception of Station 5, at Balboa Street, where a single sample, indicating 2400 + *Bact. coli* per cubic centimeter, raised the average very materially. Omitting this

sample, the average number found at Station 5, Balboa Street, was no greater for example, than that at Station 2, Sloat Boulevard, much further south.

Including the findings on all samples collected at the Stations under review, it will be seen from the figures presented in Table II that there has been a marked reduction in station averages of *Bact. coli* numbers per cubic centimeter during the period March 5, 1940 to date as compared with the average 1933-34 survey figures. This statement considers the surveys of 1933-34 and of 1940—date as two complete units. For some reason not apparent the conditions in the years 1940 and 1942, each taken as a whole, are shown to be considered better than in 1941. This condition obtained, also, during the April-October period of 1940, and the April-date period of 1942, as compared to the April-October season of 1941.

It seems to be safe to say that, with the exception of some apparently temporary badly polluted conditions, the Pacific Ocean shore waters of San Francisco were so good, prior to the recent sewerage and sewage disposal improvements, that the opportunity for betterment was not large or striking. However, a material betterment in terms of uniformly good conditions has been effected. Including all samples of the 1940-42 period the average presumptive number of *Bact. coli* for all stations under review has been well below the generally accepted standard of 10 per cubic centimeter for outdoor salt water bathing purposes. The conditions during the April-October periods were even better. The general average numbers of *Bact. coli* per cubic centimeter were 8.4 and 7.2, respectively.

Moreover, it is significant that, excluding very high numbers (690 per cubic centimeter) in two out of the 487 samples represented in the 1940-42 series, the water was practically uniform as between the several stations. See Tables II and III.

With our present knowledge it is difficult to interpret the significance or implication of the total numbers of bacteria developing on agar at 37 degrees Centrigrade. The figures are presented in Table IV. It would appear that these numbers, with one exception, have been satisfactorily low.

Physical Conditions of Shores—The physical condition of all of the north and west shore line of San Francisco from Aquatic Park to Fleishhacker Pool has been rendered vastly better, in fact fairly satisfactory, due to the sewerage and sewage disposal improvements described herein. As for the Pacific Ocean beach its physical condition, in relation to pollution by the city's own sewage solids, would seem to be well nigh ideal.

Items for Consideration and Discussion—The general problem of the determination of the values which accrue from improved sewerage and the introduction of sewage treatment works and, further, the proper methods of approach to that problem, would seem to be matters which might well be reviewed by a group such as our California Sewage Works Association. Some of the questions which could perhaps be considered and discussed with profit are:

(*a*) How much is a clean public environment (in contrast with the personal or private environment) worth, expressed in both social and economic terms?

(*b*) Are citizens willing to make large expenditures for environmental clean-

ness, as related to their communities, for the same fundamental reason that they willingly expend large sums and much personal energy, upon keeping themselves, their apparel and their domiciles clean; or is the public environment too remote?

(*c*) To what extent are polluted outdoor salt bathing waters concerned with the public health, and what are the corroborative data?

(*d*) Is it in the public interest to argue a public health menace due to shore and shore water pollution in the absence of substantiating vital statistics; or are such data available?

(*e*) Is a standard of 10 *Bact. coli* per cubic centimeter in such waters most rational; and to what extent has it been definitely tested?

(*f*) Does the total bacterial count on standard agar plates incubated at 37 degrees centigrade have any relationship to what may be termed the general clearness of the water; and, if so, what are the tolerable limits?

(*g*) To what extent have bacterial surveys been made to determine shore water pollution reduction through sewage treatment and improved outfall conditions; and what have been the results?

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R. D. Woodward and Arthur J. Grant, former chief and assistant operator, respectively, of the Laguna Beach Sewage Treatment Plant, are now working for the West Coast Shipbuilding Co. at Newport Beach.

PROBLEMS OF DISPOSAL OF PEACH AND TOMATO WASTES FROM THE LARGEST CANNERY IN THE WEST

By GROVER L. WALTERS*

For the past several years the wastes from cannery and juicing plants in Fullerton have been a contributing factor in the problem of sewage disposal affecting the Joint Outfall Sewer System of Orange County. The problem differs in degree and kind at various points of the system, but in general involves two elements in common, namely, nuisance and added expense.

The plant of the Val Vita Foods Products, Inc., the largest food products establishment of its kind in the west involving tomato and peach canning along with other allied operations, has been contributing its entire wastes to the Fullerton Sewage flow.

During the year 1941, the consumption of water at this cannery was 171,519,700 gallons. The consumption for the current year inclusive of the 16th day of September marking the close of the peach canning season was 155,165,900 gallons.

The pack of peaches for the 1942 season, over a period of 50 days amounted to 15,000 tons aggregating 747,000 cases. The pack of tomatoes is just starting with only 3,000 tons so far this season. It is estimated that the tomato pack will amount to 1,000,000 cases.

From the foregoing, it is apparent that in relation to both volume of flow and quantity of organic solids handled by the sewer system, the cannery wastes of the Val Vita Food Products Plant are responsible for a considerable part of the city's share of the total cost of sewage disposal within the system, especially as regards pumping and treatment.

As a consequence of vigorous complaints of nuisances and possible danger to health on the part of residents along the main line and at the beaches, resulted in action by the City of Fullerton to remove as much as possible of Val Vita Cannery Wastes from the sewerage system of Fullerton.

Instead of receiving into the municipal sewer system cannery wastes from Val Vita Food Products Plant in uncontrollable amounts and concentrations, consideration has been given by the City of Fullerton to the desirability of regulating and pre-treating the wastes prior to discharge into the sewers, as a matter of equitable public policy. Under these circumstances the City and the Val Vita Plant have an understanding whereby the cannery is to conduct its operation in such a manner as to reduce the production of wastes entering the sewers to a reasonable minimum, and at the same time install and operate as soon as possible such pre-treatment devices as will remove from the wastes excessive amounts of suspended solids, so as to make the wastes have more nearly the characteristics of domestic sewage so far as organic loadings are concerned.

Taking into consideration the requirements of disposal through the Outfall Sewer System it does not appear necessary that the cannery wastes be

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treated by other than mechanical means, as distinguished from chemical precipitation or biologic oxidation.

Due to the shortage of critical materials necessary to construct the type of pre-treatment plant experience dictates now, an attempt has been made this season to remove the entire flow of the Val Vita Cannery peach and tomato waste from the Fullerton Sewer System.

The flow now as it leaves the cannery passes into a wet well from which it is pumped through a series of rotary fine screens. The screens, two in number, are each 10 feet long and 6 feet in diameter. The wastes are pumped through the first screen with the second screen receiving the flow by gravity. These two screens under the best operating conditions are capable of removing approximately 60 barrels or 3000 gallons of screenings per day.

The layout of this screening operation is so arranged that the wastes leaving the second screen can either be pumped onto the 120-acre tract of land owned by the cannery or by-passed into the Fullerton sewer system.

At the beginning of the peach canning season this year the Fullerton sewer was completely plugged off from the cannery with the result that all peach waste entering the screens was pumped to an outlet on the cannery's land for spreading. From this point an attempt was made at spreading without due preparation as to methods of ponding. A low dyke was pushed up around the exterior borders of the spreading area with the result that all of the water collected in the lower reaches of the land overflowing dykes and flooding neighboring property. This was the first time in the history of the cannery that sewage troubles had been a direct concern of theirs.

As the land on which the cannery is ponding their effluent lies adjacent to the Brea Flood Control Basin Channel the first impulse of the cannery management was to use this channel as a means of disposal, and accordingly a trench was cut through the embankment allowing the entire flow of approximately 1000 G.P.M. of peach and tomato wastes to flow into this channel.

The Brea Flood Control Channel discharges into Coyote Creek, thence into the San Gabriel River, and thence into the Pacific Ocean. During this trial run of channel disposal, rotary screening was discontinued so that all of the wastes found their way along the course of the channel and its continuing receiving courses, with the result that after nine days the local county board of health was flooded with vigorous complaints of odor nuisance. The cannery was immediately directed to discontinue the use of the channel and close the cut in the embankment and spread chloride of lime for the full length the waste traveled.

During the remainder of the season, provisions have been made for the cannery wastes to be pumped onto the land and such amounts as the acreage cannot absorb may be discharged into the present sewer main.

A conference has been held with the Val Vita Foods Products management recently at which time they recognized their responsibility in providing adequate pre-treatment facilities at the earliest possible date and in the meantime the proper preparation of their land area for maximum absorption.

CHARACTERISTICS AND TREATMENT OF POTATO DEHYDRATION WASTES

By **HAROLD FARNSWORTH GRAY*** *and* **HARVEY F. LUDWIG****

Vegetable dehydration wastes may be classified, at least at present, as war production wastes. The necessity for transporting overseas, with a critical shortage of shipping facilities, the great quantities of vegetables required by the Army, Navy, and Lend-Lease has resulted in a tremendous expansion of the vegetable dehydration industry. Prior to the war stimulus the normal dehydrated vegetable production in the United States amounted to about 3000 dry tons annually; this year, 1942, it is estimated that some 50,000 dry tons will be prepared. A majority of the vegetable dehydration plants have been located on the west coast, particularly in California, where numerous fruit dehydrators have been available for ready conversion to vegetable drying. Seven vegetables have been of major importance in the dehydration program, viz., white potatoes, onions, cabbage, carrots, sweet potatoes and yams, beets, and turnips. Of these, the white potatoes have been most important, constituting possibly half of the total production.

Liquid wastes resulting from the dehydration of potatoes and other root vegetables such as carrots, turnips, etc., are derived from the processing operations preparatory to drying. Figure 1 illustrates a typical plant flow sheet, in which it is seen that prior to drying the potatoes are peeled (mechanically), trimmed (manually), diced or otherwise cut up into small segments or shapes, washed, and steam blanched. The product is then spread on the drying trays, and these are stacked onto trucks and passed through the tunnel driers. The liquid wastes are associated, as indicated by the double-line boundaries in Figure 1, with the operations of peeling and of washing after cutting. Abrasive carborundum units, either batch or continuous, are generally employed for peeling, the surface of the potato being simply rubbed off to the desired degree of peeling, and the remaining bits of skin, eyes, etc., being later removed by manual trimming. The rubbing action is carried out under water sprays, and the rubbed-off material is piped from the peelers as a liquid waste. The operation of washing the cut potato shapes is necessary to remove the surface materials which would otherwise cause sticking and matting of these shapes when they are later dehydrated. This washing operation employs water sprays, these frequently being incorporated in the structure of the steam blancher. Separate barrel and other type washers may also be used. The washings are collected by floor drains, and are hereinafter described as the spray washing wastes. There are also intermittent plant washing wastes, most plants being hose-cleaned after each shift; but these are of small quantity and significance. The trimming wastes are removed as garbage. Dehydration plants usually operate 24 hours daily, seven days per week, as it is costly to break the drying cycle.

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Characteristics of Abrasive Peeler Wastes: The percentage of the initial weight of potato rubbed off in the abrasive peeling operation varies over wide limits. Under very favorable conditions, with properly sorted potatoes of good size and quality, these losses may be as low as 12 or 15%. Generally they will be greater, particularly if the potatoes are not sorted, are excessively irregular, have rough surfaces, or have become softened by improper storage. Losses of 30% and more are not uncommon. The losses will also depend of course upon the degree of peeling desired, or, in other words, upon the amount of skin to be left for removal by hand trimming. Usually the potatoes are mechanically peeled to a high degree, only some eyes and irregularities remaining.

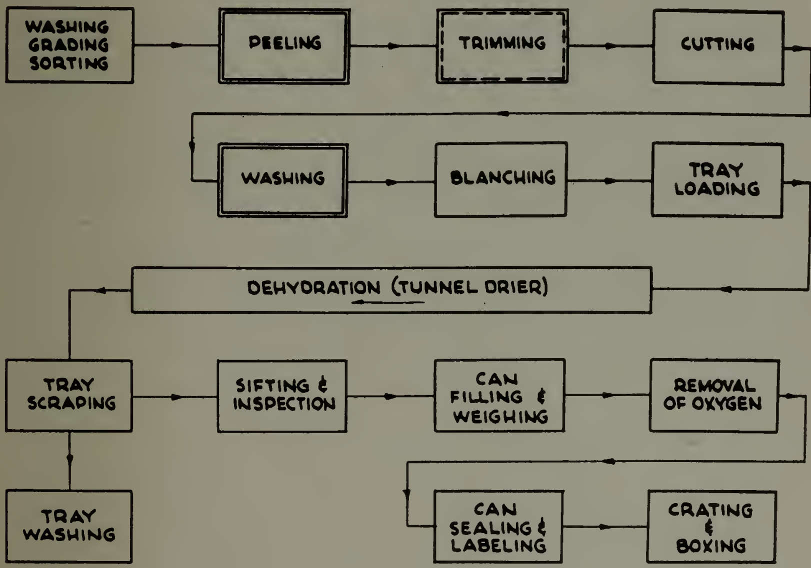


FIG. 1: TYPICAL FLOW SHEET FOR ROOT VEGETABLE DEHYDRATION PLANT

General characteristics of abrasive peeler wastes are given in Table I. These wastes amount to approximately 600 gals. per ton of potatoes handled; for an ordinary sized plant of about one ton per hour capacity this will equal 14,400 gals. per day. Since the organic loading carried by these wastes will be proportional to the percentage loss in the peelers, this loading has been expressed as the quantity of B.O.D., suspended solids or other constituent, per ton of potatoes handled per percentage of loss in the peelers. Considering the 5-day B.O.D., for example, the peeler wastes will contain approximately 1.0 lbs. B.O.D. per ton per percentage; and in the usual plant (peeler losses 20%) of ordinary size (one ton per hour) this will amount to 1.0x-20x24 or 480 lbs. B.O.D. daily, equivalent to a population of roughly 4500.

The settleable solids for these wastes are high, equal to 0.7 cu. ft. per ton per percentage, or about 335 cu. ft. daily for the 24-ton plant mentioned above. Ninety percent of the settleable solids are removed during the first 10 minutes settling, this representing the coarse pieces of potato. During the next 20 minutes a layer of fine starch particles settles out, these particles later permeating to the bottom of the mass of sludge. Further removals can be effected by chemical flocculation, but very high dosages are required.

On standing the abrasive peeler wastes quickly undergo decomposition with the production of a nauseating odor typical of fermenting starch. The pH drops during the first 24-48 hours, reaching a value of 5.0-5.5, after which further change in the pH will depend upon the particular types of organisms present.

TABLE I: CHARACTERISTICS OF POTATO DEHYDRATION WASTES

	Abrasive Peeler Wastes	Spray Washing Wastes
Quantity of Flow	......	......
Gal per ton (of potatoes dehydrated)	600.	2,500
B.O.D. (5-day, 20° C) (bicarbonate dil. water)	......	......
Parts per million (approx.)	4,000.	1,000
Lbs. per ton per % loss (in peeling)	1.0	......
Lbs. per ton	20.	20.
Lbs. per lbs. dry potato solids	0.20	......
% removed by screening (60 mesh)	20±	0
% removed by 10 min. settling	30±	Little
Suspended Solids (with Whatman 40 paper)	......	......
Parts per million (approx.)	18,000.	1,500.
Lbs. per ton per % loss	4.5	......
Lbs. per ton	90.	30.
Lbs. per lbs. dry potato solids	0.90	......
% removed by screening (60 mesh)	30±	0
Settleable Solids (2 hrs. detention)	......	......
Ml. per liter (approx.)	185.	12.
Cu. ft. per ton per %	0.7	......
Cu. ft. per ton	15.	4.
Cu. ft. per lb. dry potato solids	0.15	......
% removed by screening (60 mesh)	80±	0
% removed by 10 min. settling	90±	Little
pH (approx.)	6.5	6.0

NOTES:

The ppm. and lbs. per ton values for the peeling wastes correspond to an assumed peeling loss of 20%.

Solids concentration of potatoes 25%.

In determining the B.O.D. of the peeling wastes the sample was macerated for 10 min. in a Waring Blendor, diluted 1:9 with water, and then mixed 1:3 by volume with domestic sewage. The B.O.D. of the peeling wastes was computed from the values for the mixture and for the domestic sewage.

REFERENCES CITED:

(1) Winton, A. L. and K. B., *The Structure and Composition of Foods,* Vol. II, Wiley and Sons (1935).

Characteristics of Spray Washing Wastes: General characteristics of these wastes are given by Table I. They amount to about 2500 gals. per ton of potatoes handled, roughly four times the volume utilized for abrasive

peeling. The total organic matter carried by these wastes is about equally divided between: (1) a soluble fraction, and (2) a suspended fraction consisting of fine starch particles, most of which will be removed in a 30-minute laboratory settling period. The organic loading for these wastes will vary considerably at different plants, depending upon the amounts of surface area exposed by the different methods of cutting (slicing, dicing, shredding, etc.). Table I represents the usual case where the potatoes are extruded or stripped into small elongated bars. Although the volume of these wastes is large compared with the peeler wastes, their concentration of organic matter is very much less. For the ordinary sized plant of one ton per hour capacity the total daily volume of these wastes will be about 60,000 gals., containing about 480 lbs. of B.O.D., equivalent roughly to a population of 4500, about 720 lbs. of suspended solids, and about 96 cu. ft. of settleable solids.

Composition of the Potato: The organic matter making up the whole potato may be classified (1) in three parts: the skin, the cortex, and the pith or flesh. The cortex ring has a thickness of about one-tenth the potato breadth, and practically all of this is removed by abrasive peeling. Both the cortex and pith contain on the average about 20% solids, comprising about 16 percentage units of starch, 2 of protein matter, 1 of ash, and ½ each of fiber and sugars. Approximately 15% of the organic (non-ash) solids are soluble in water. The solids content of different potato types varies considerably, over a range of about 15 to 30%. Utah-Idaho varieties have the highest solids concentrations, Rocky Mountain types the least, and eastern potatoes are intermediate. Other factors which may considerably influence the solids composition of the potato are seasonal variations, methods of culture and storage. The solids content of different root vegetables are also different; carrots and rutabagas, for example, have average concentrations of only about 10%.

The "per ton per percentage" values given for the abrasive peeler wastes in Table I correspond to potatoes of high solids content (25%), these of course being preferred for dehydration purposes. Since these values will vary with different solids contents, it seems desirable, for purposes of comparing different types of potatoes or even different root vegetables, to express the B.O.D., suspended solids, or other constituent per unit weight of dry vegetable solids contained in the wastes. These data have been included in Table I.

Waste Disposal at Modesto: At the Modesto, Calif., plant of the Pacific Coast Dehydrated Products Co., Oakland, Calif., the spray washing and the screened peeler wastes are combined and disposed of by irrigation. Figure 2 illustrates this plant, which at the time of sampling was operating at about 28 tons daily capacity. The abrasive peeler wastes are piped to a vibrating 60-mesh shaker-screen which removes the coarser particles (representing 80% of the settleable solids, 30% of the suspended solids, and 20% of the B.O.D.). The screen effluent flows by gravity to a pump sump. The various spray washing wastes are collected into this same sump by means of a floor channel running beneath the line of equipment. The combined wastes are pumped continuously to one of the disposal beds, the flow velocity being adequate (one foot per second) to prevent settling of starch in the pipe. Seven disposal beds, each about 20 ft. by 170 ft., are used in rotation. A new bed is placed in service each 24 hours, beginning at 7 o'clock in the

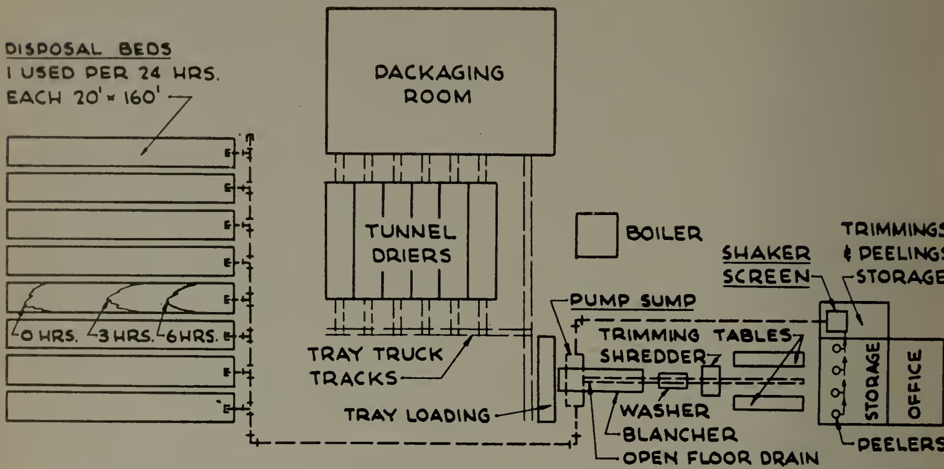
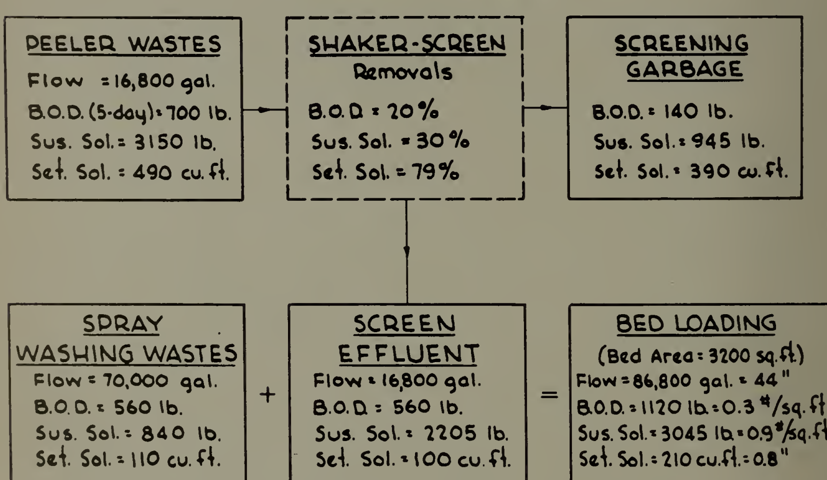


FIG. 2: MODESTO POTATO DEHYDRATING PLANT PACIFIC COAST DEHYDRATED PRODUCTS CO. OAKLAND, CALIF.



Quantities represent totals per 24 hrs. and correspond to 25% peeling loss

FIG. 3
WASTE DISPOSAL AT MODESTO – 28 TON DAILY CAPACITY

morning at the change in shifts. In figure 3 are shown the total 24-hr. quantities of flow, 5-day B.O.D., suspended solids, and settleable solids at various stages through the plant.

The period of time required for the beds to dry varies with weather conditions, but during the month of September, characterized by ample sunshine and mild winds, all the surface water percolated into the ground by about six hours after the flow had been shut off. This represents a total percolation time of 30 hours, and an effective percolation rate of approximately two inches per hour. This rate is high, as would be expected by the sandy nature of the soil. The soil has been identified as Delano fine sandy loam, and has a porosity of 50%. An experimental laboratory test showed the percolation rate of clear water through a 12″ column of this material under an initial head of 12″ at 20° C to be 3.0 inches per hour.

The exposed starchy sludge mat dries very readily, even in the deepest areas. About 30 hours after disappearance of surface water the sludge has reached a moisture content of approximately 30%, at which point it is sufficiently dry for shoveling. The sludge is shoveled from the beds into piles and then onto trucks for removal as garbage. The beds are disced soon thereafter. No clogging of the soil could be observed on discing, and although the beds had been operated only a few weeks at the time of these studies, it is believed that their capacity to absorb these wastes will not be substantially decreased by clogging.

The disposal beds are practically free from all but slight odors, and very little if any odor can be detected more than 50-100 ft. from the beds. Odors develop only when the sludge is maintained fairly moist for long periods of time. The most odor occurs when the sludge is shoveled from the beds, but this disappears very quickly.

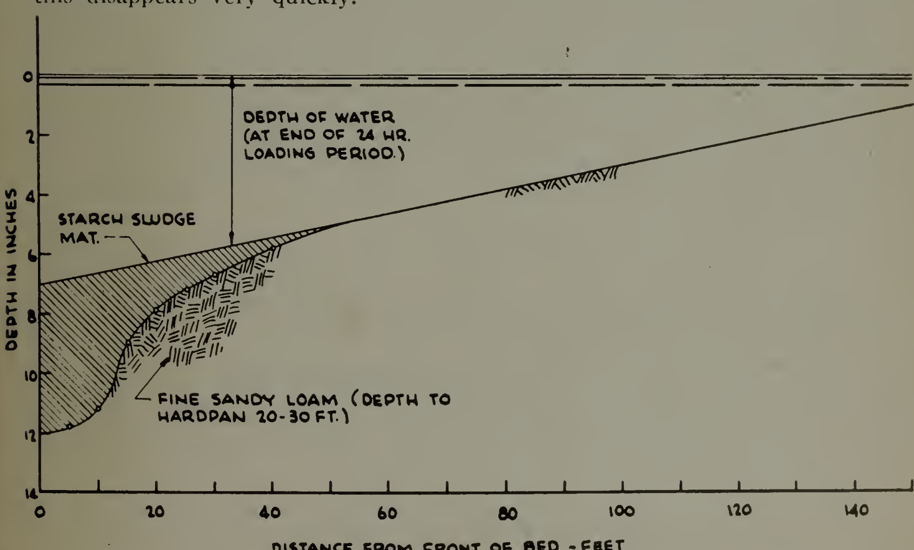


FIG 4: PROFILE OF DISPOSAL BED ALONG LONGITUDINAL CENTERLINE

Recommended Disposal Methods: In very few dehydration plants would the installation of advanced treatment (such as chemical flocculation or biological oxidation) be justified. If such a high degree of treatment is essential, due to conditions of final disposal of the effluent, it may be cheaper to shut down and move the plant to a more favorable site. In most cases the best solution appears to comprise primary sedimentation plus disposal of the effluent by irrigation. Where excellent percolating beds are available, as at Modesto, no pretreatment is really essential, as the initial sections of the beds themselves can serve as primary settling units. Generally it will be best to provide a primary settling tank (such as a Dortman tank) with a design detention period of not less than 30 minutes, and with provision for removal of sludge accumulations at least daily. This will effect removal of most of the settleable solids, including the fine starch particles which might readily clog an ordinary soil. These fine starch particles might also cause trouble, if not removed, by settling out in conduits or sewers and forming a hard bottom mat. The percolating properties of the soil may be measured by a simple hydraulic test, and the necessary area estimated accordingly. Inasmuch as the wastes percolating into the soil are predominately acid, it is improbable that the permeability of the soil will be lessened by base-exchange reactions. Other effects which might possibly result from addition of this supply of hydrogen ions to the ground water can only be conjectured.

Other Methods of Peeling: The peeler waste characteristics described above are based on the use of the abrasive type peeler, this type now being in common use. It is quite possible that this method of peeling will become obsolete and be supplemented by improved methods, such as flame peeling and lye peeling, which can remove the skins with much smaller losses. Whatever the method of peeling, the organic loadings of the liquid peeling wastes can be estimated from Table I by multiplying the values expressed per unit percentage peeling loss by the percentage loss actually obtained (with a correction for differences in solids content). With either of the new methods mentioned it will probably be possible to reduce peeling losses to values of 5% and less.

Harvey F. Ludwig was commissioned on November 26, 1942, as Assistant Sanitary Engineer in the Regular Corps of the U. S. Public Health Service, after having successfully passed the six-day examination given in October. Harvey has spent the last several months at Bethesda, Maryland, attending a short course on U. S. P. H. S. Orientation. He expects to be back in Atlanta, Georgia, by March 1, to take up his duties in the Office of Malaria Control in War Areas.

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Professor Henry J. Miles, associate professor of civil engineering at the University of Southern California, has recently moved to California from Florida. Professor Miles was with the Civil Engineering Hydraulics Laboratory of the University of Florida, and a member of the Florida Sewage Works Association.

VENTILATION OF LARGE SEWERS IN THE CITY OF LOS ANGELES

By **H. G. SMITH***

As an introduction to the subject it may be of interest to quote a few extracts from a report by Dr. Rudolph Hering made in October of 1899, at which time he was called in as a consultant to the City Engineer of Los Angeles, Mr. J. H. Dockweiler.

After describing the condition of the sewage and the state of deterioration in the then existing outfall sewer since abandoned, Dr. Hering goes on to say that "The remedy for the trouble should be sought either in protecting the interior surface of the sewer by an imperishable coating or by such a thorough dilution of the injurious gases that they will no longer be sufficiently intense to effect the cement. It has been suggested to protect the interior surface with a coating consisting practically of sulphur and silica as experiments have been made to show its efficiency. In view of the fact that such a process would be very difficult to apply in the sewer at the present time, that it would be expensive and that as a thorough draft of air alone would accomplish the desired purpose, it does not, in my opinion, warrant adoption. * * * A thorough dilution of the gases is at the present time the cheapest cure of the evil, and so far as it goes, thoroughly effective."

Thus it may be seen that the ventilation of a sewer as a protection from deterioration is not a new idea and, at least in essence, the City is finally adopting the wise recommendation made by Dr. Hering over forty years ago.

After a study had been made of the data obtained by Assistant Superintendent R. F. Brown in his quite well known inspection trip through the lower section of the North Outfall sewer in 1936, it became imperative that more or less drastic measures be taken to stop as far as possible the corrosive action taking place on the interior surfaces of the structure due to gases generated by the sewage.

Repair of the interior of the structure was impractical for a number of reasons. Chlorination, successfully accomplished in the County Sanitation District outfalls, was too costly considering the great quantity of liquid involved and the condition of the sewage.

With the exception of a large sewer in Australia, to the best of our knowledge no work had been done in the way of forced ventilation on a large scale. Fortuitously we were visited at about the time the matter became pertinent by several prominent Australian engineers, among them Mr. E. F. Borie, engineer of sewage for the Melbourne and Metropolitan Board of Works, who furnished us with considerable data, and incidentally encouragement relative to ventilation in a large sewer under conditions very similar to our own, where very satisfactory results were being obtained.

As our experimental ventilation installation on the lower section of the North Outfall Sewer was very ably covered in a paper prepared and presented by the supervisor in direct charge of field operation, Mr. E. G. Studley, before the Sanitary Group of the American Society of Civil Engineers,

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and later published in the 1939 July issue of the Sewage Works Journal, I will only here touch upon the highlights.

The critical section of the North Outfall I am about to discuss, extends from the siphon under Centinela Avenue to the Hyperion Screening Plant at the ocean terminus, a length of six miles. The cross section of the structure is semi-eliptical, the vertical dimension 10.5 feet and the horizontal 12.3 feet. It was built in 1922 of unreinforced concrete lined with cement-jointed tile, has a carrying capacity of 450 second feet and flows approximately two-thirds full at dry weather peak.

The experimental equipment consisted of a sawdust type blower which delivered about 22,000 cubic feet of air per minute and was belt driven from a 75-H.P. diesel engine.

Air was admitted to the sewer through sliding apertures in the covers of about 14 manhole openings, the entire distance amounting to nearly three miles. A canvas brattice installed at the last manhole separated this ventilated portion from the remainder of the section.

For some time daily records were made of fan speed, quantity of exhausted air, wet and dry bulb temperatures of the exhaust air and atmosphere, hydrogen sulphide content of the exhausted air, vacuum in the suction, pressure on the discharge side and quantity of air admitted at the controlled manhole openings.

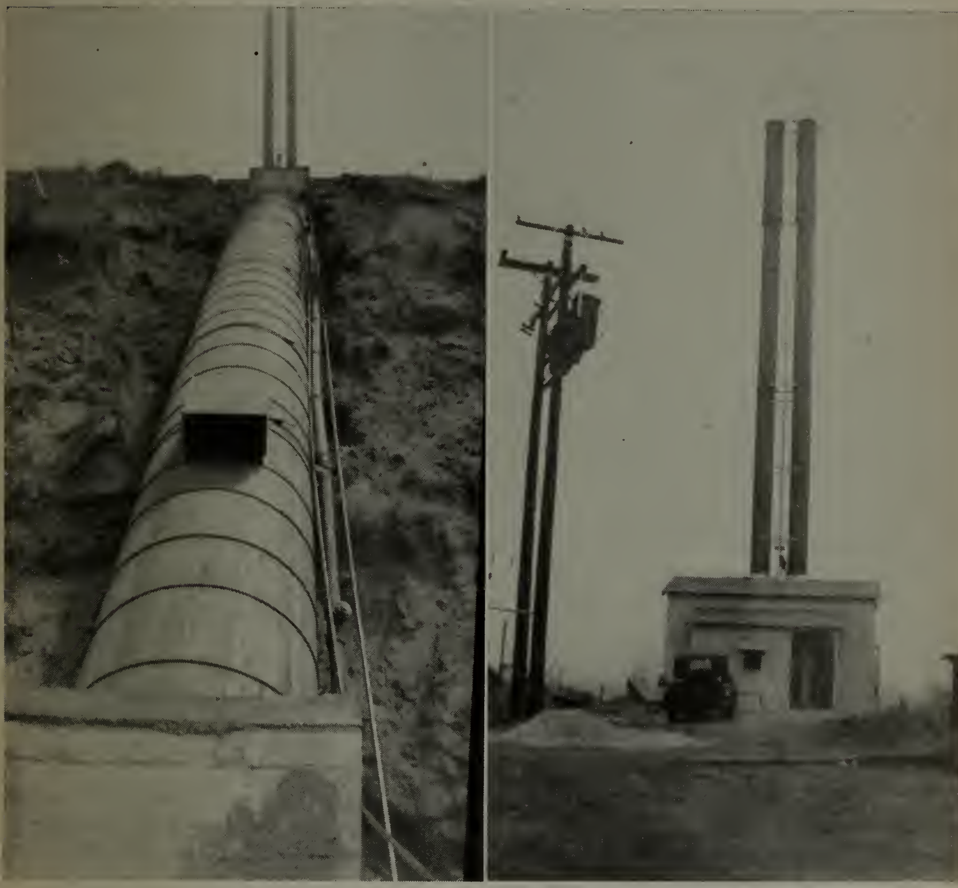
The results obtained were quite gratifying. Where, prior to ventilation, the sides of the interior walls were covered with a wet stringy substance composed more or less of sulphides, this matter entirely disappeared. The tile became dry and the cement joints which had formerly been of the consistency of soft putty dried and hardened. In fact, the interior surface gave the appearance of a new sewer. Cement blanks installed at a number of different locations after ventilation was commenced, some above normal peak flow, others between high and low flow surface showed no indication whatsoever of deterioration after having been in the sewer for several years.

Meanwhile the exhausted air carried a humidity of 100 per cent and a hydrogen sulphide content of 16 p.p.m. a considerable portion of the time. The stack velocity averaged 150 feet per second, the top or discharge point of the stack being only about 15 feet above the crown of the arch.

This experimental plant was placed in operation early in January 1938, and was continuously in service except during heavy rains, until October, 1941, when it was shut down due to extensive repairs necessary on the engine. It was believed the permanent plant could be placed in operation in such a comparatively short time that the sewer could in the meantime remain unventilated. However, due to war conditions, the installation of the new plant has been greatly delayed.

The above results proved so satisfactory they led to the decision to construct a permanent station at a midway point on the six-mile sewer section. This station, known as No. 1 and 2, is at this writing very nearly completed.

The equipment is housed in a stucco walled building located on the crest of the mesa some one thousand feet easterly from Falmouth Avenue in the Playa del Rey area. This location is 90 feet above and 170 feet distant from the North Outfall sewer, connection being made thereto by a 54-



***Left*—Looking up from outfall 12-foot diameter sewer. Shows wooden 54-inch intake suction pipe with inspection manhole opening. Pipes at side in trench are sewer for plant, water line, and flow measuring electrodes conduit for automatic operation during peak and low sewage flows. *Right*—Wooden stacks with noise silencers at top. Elevator cage can be seen between stacks at top of roof of the new ventilation station building.**

inch wood stave pipeline buried in the slope. The two legs of a wye-shaped transition at the upper end of the pipeline connect with the suction side of the blowers.

The two blowers were manufactured by the Utility Fan Corporation of Los Angeles. Each blower is guaranteed to deliver 22,000 cubic feet of air per minute against a static pressure of 15 inches of water operating at 1775 r.p.m., and with an outlet velocity of 3600 feet per minute.

The blowers will be driven by direct connected 75-H.P. U. S. motors secured to steel bases bolted to the fan housing. The entire unit is insulated from the concrete slab by two inches of cork and two inches of wood.

The exhaust side of each blower is individually connected by a metal

transition to one of two wood stave stacks, 27 inches in interior diameter and throtted to 18 inches at the outlets which are 80 feet above the ground. The discharge velocity at the outlets is over 200 feet per second. The stacks are provided with vermiculite filled silencers and a one-man, manually operated elevator constructed between the two will permit test observations to be made in safety.

Self-operating gates in the transition permit the blowers to be run individually while electrodes in pipe wells beside the sewer will automatically shut off the current during extreme high water. Time clocks on the switchboard, which is located in a separate room, permit starting and shutting down at predetermined times if desirable without the presence of an attendant.

Experimental work had hardly well started on the lower North Outfall sewer ventilation in the Spring of 1938 when many hundred emphatic complaints were received from a considerable area to the north and east of Fletcher Drive and San Fernando Road. Investigation indicated that this odor was the result of gases produced in the Glendale section of the North Outfall sewer finally escaping from the roof vents of houses in the affected area.

Further investigation developed the fact that the new siphon under the Los Angeles River at Fletcher Drive made necessary by the U. S. Government improvements to the river channel acted to shut off the previous free flow of gas and air up and down the outfall with the result that it backed up from this point, flooded back through the laterals and finally found an outlet by way of the roof vents.

It might here be mentioned that it is now our policy where possible when constructing a siphon in a line of any size, or when the sewage is septic, to provide a by-pass for gas and air circulation.

However at the Fletcher Drive siphon this expedient was not practical. A study was made relative to installing an individual siphon at the junction of each lateral and interceptor as it entered the outfall above the siphon under the river, but this also proved impractical.

It was then determined that sufficient odorous air must be removed from the outfall at some point near the siphon to prevent this back draft. While the problem of removing the air was simple, that of removing the odor before discharging the air to atmosphere in a location surrounded by residences was not.

The more air taken out the greater difficulty in removing odor, so in the first experiments which were conducted at a station installed at the Fletcher Drive bridge no blower was used, but a vent provided to permit the air to flow out and through a hot spot induced by burning commercial gas. While the odor was destroyed the quantity of gaseous air removed was inadequate.

As quite good results had been obtained relative to odor elimination at the large plant on the lower section of the outfall previously described, by using a high velocity in the stack discharge it seemed worth trying in this particular problem. A new location was selected one thousand feet down the river and immediately adjacent to the siphon.

Here, after experimenting with a small blower operated by a Ford engine and passing the air through a hot spot it was decided that larger equip-

ment was necessary, and a Buffalo blower of 1200 cu. ft. capacity driven by electric motor through multiple V belts was installed.

As this new location on the river bank was directly in the rear of a motor court whose owner was decidedly prejudiced at the beginning and who proved later definitely hostile to the entire proceding, we were never quite sure as to the actual justification of the innumerable complaints the lady raised. Fortunately, several conservative residents in the neighborhood were very helpful, stating actual conditions in their vicinity from time to time, whereupon adjustments could be made improving the situation.

The two principal sources of complaint in the vicinity of the blower station were odor and the noise of air escaping from the stack. It was found after increasing the height of the stack to 60 feet, that when a stack velocity of 150 to 160 feet per second was maintained there were no odor complaints. This became very apparent when trouble was experienced with belt slippage, lowering the fan speed. When this slippage occurred complaints were received almost immediately and promptly ceased when corrections were made. However, the noise caused by the air leaving the stack was very objectionable for a distance of several thousand feet, particularly at night.

For a time we were in a quandary. If the speed was raised, complaints came in of noise. If it was dropped, more people complained of odor. And if the plant was shut down for any great length of time, complaints again came in from the original area. After much experiment this noise was entirely eliminated by installing a silencer in which vermiculite is the absorbing medium.

It may be of interest to here note that at about this time a complaint of noise was received from a sanitarium a mile and a half distant from the experimental blower station in operation on the lower outfall sewer. The complaint stated that after midnight when the noise of automobiles had quieted down, the steady whine of the stack discharge became very penetrating, causing serious unrest among the patients who had various psycho-alcoholic troubles. A vermiculite type of silencer was installed and no further complaints were received.

Results at the Fletcher Drive experimental station finally proved sufficiently satisfactory to design a permanent installation. This station, known as No. 8, was constructed and finally placed in operation in October, 1941. The station is located about 1100 feet down the river from the experimental plant described, and is some 1000 feet from the nearest residence. The connecting suction line from the siphon chamber to the station is of vitrified pipe 27 inches in diameter.

The equipment consists of a Buffalo type No. 3 blower guaranteed to deliver 7000 cubic feet of air per minute against a static pressure of 22 inches of water at 3500 r.p.m. with fan directly mounted on the shaft of a 40-H.P. U. S. motor, both blower and motor bolted to a steel base. The exhaust is through a transite pipe 14 inches in diameter extending 80 feet into the air and provided with a silencer. This exhaust pipe is supported by a steel tower, somewhat resembling an oil derrick, provided with ladders for reaching the platform at the top. The building, which is partly in the

river bank is of stucco with switchboard set into the exterior side wall and protected by hinged doors.

The plant originally was placed on a 24-hour operation basis and no complaints of any kind have thus far been received either from the area in which the back draft occurred or in the vicinity of the plant.

After operating for a month or so, it was found that satisfactory results could be obtained with the equipment running a few hours in the morning and again in the afternoon. This is accomplished by means of a time clock, and the plant requires very little attention.

The purpose of the ventilation so far described is being accomplished for protection against corrosive action and odor nuisance, respectively.

In past years several violent explosions have occurred in the Slauson Avenue intercepting sewer. Manhole covers were blown into the air over a half-mile section, and it was only through good fortune that no one was killed or injured. The area drained by this interceptor is largely industrial and at times certain types of liquids are discharged into the sewer that later give off explosive gases. To prevent reoccurrance of these explosions it was determined to ventilate at least the critical section of this intercepting sewer.

A location was chosen several hundred feet southerly of the Slauson Avenue south property line and in a neighborhood in which the industries provided so many varied unpleasant odors that it seemed a little sewer gas added in would be lost in the general mixture.

The plant, known as Ventilation Station No. 5, built with W.P.A. labor, was completed and placed in operation in April, 1941. Gaseous air is taken off from the sewer and conveyed to the plant through a 24-inch vitrified clay pipe, formerly connected to the suction side of the blower, to be discharged through a vertical 12-inch vitrified pipe enclosed in a reinforced concrete stack 30 feet in height.

The blower is an American type No. 4, guaranteed to discharge 2500 cubic feet per minute against a water pressure of 12½ inches at 3500 r.p.m. The fan is directly connected to a 7½-H.P. Sterling motor.

After an experimental run it was decided the stack height should be increased in order to top an adjacent building which formed a lee when the wind came from the southwest, its usual fair-weather direction. Therefore, a steel stack 40 feet in length was added, giving a total height of 70 feet.

Within a comparatively short time after beginning operation several vociferous complaints were received from adjoining junk yards. Investigation by representatives of the Health Department and Sewer Division for a time failed to find any just cause for complaint. However, it finally developed that this odor came as the result of what might be termed bursts, lasting ten minutes to a half hour, after which there was no indication of sewer gas in the vicinity for possibly several hours.

Chemical tests later indicated that these "bursts" often carried as high as 120 p.p.m. of H_2S and are apparently caused by the dumping of certain waste matter into the sewer, this matter combining with the sewage to form large quantities of gas.

Arrangements were immediately made to commence experimental work to eliminate odor from the sewer gas by means of chemical sprays. For a time this work was conducted at the large Venice Pumping Plant. For

greater convenience and accessibility operations were later moved in to the Slauson Avenue station.

Here the old equipment was rebuilt and the detention spray period was increased from 3 to 7 seconds.

During this phase of the research, Mr. Ralph Stevenson, a well known chemist, who is interested in the deodorization of gases, worked with us for a time, offering valuable suggestions and checking over results.

As the work proceeded and different chemical combinations were used, a considerable improvement was made, but it became evident that regardless of the type of chemical, each individual particle of the air flow must be contacted by spray. This called for an improvement in nozzles and additional detention.

Up to this time all experimental apparatus had been constructed of marine plywood, lumber and metal pipe. The largest quantity of gas withdrawn for test had amounted to 1300 cubic feet per minute while quantities as small as 300 were treated.

In order to operate the station blower at full capacity, and give the gas what might be termed preliminary and final treatment, if desirable, four brick towers each four feet square and ten feet in height, with wooden covers, were built adjoining the blower building, ducts being designed in such a manner that the gases pass up and down through these towers while being sprayed. Meanwhile hard rubber spray nozzles of our own manufacture were installed in each tank. The sprays are operated by means of pumps which recirculate the chemical liquid after it has drained from the bottom of the brick towers to a regenerating tank. The detention period or passing-through time in each tank is four seconds.

Originally all gas had been treated after passing through the blower. The final innovation was to change this over, drawing gas directly from the pipeline from the sewer, treating it in the towers, passing it through elimination plates, to remove moisture and then to the suction intake of the blower.

In a paper of this length I have not attempted to go into much of the detail involved in these experiments. Several types of sprays have been used and many different chemicals and combinations tried out both on the acid and alkaline side. At present we are using a combination of a comparatively small quantity of chlorine and soda ash in water as a liquid spray and analysis indicates that all of the hydrogen sulphide is being removed from the noxious air. The liquid drains back from the towers to a regenerating tank and is again pumped through the sprays, chlorine being introduced just prior to entrance into the pump suction.

At this writing, the early part of September, Station No. 5 has been in operation for several weeks and no complaints received. In fact, one former complainant, cognizant of experimental work, asked when we were going to start up.

Although it has been our experience that a high stack discharging gas at from 150 to 200 lineal feet per second entirely eliminates low, and greatly reduces high concentrations of odorous gases, it would seem that a station with a low velocity and gas treated by spraying with non-expensive chemicals, although costing more to install, would be less expensive to operate and

also be more positive and adaptable. Although it is felt that considerable progress has been made, we believe that experimental work along this line is far from an end point.

As we all know, there is no definite line of demarkation to be arrived at relative to odor, as the personal equation enters into the problem. Often those working on the experiments become so accustomed to certain odors that they lose their sence of detection for the time being. Again imagination and prejudice plays a considerable part. Certain people seem to believe that if the word sewage is used they must immediately detect a bad odor in order to be thought aesthetic.

Odor determinations by the osmoscope on a numerical basis are interesting and under certain conditions instructive and helpful, but the final answer, however, regardless of what any engineer or chemist may think, is the effect on the neighborhood. If there are no complaints after a reasonable period of operation under the various wind, barometric and temperature conditions prevalent in the particular area, your treatment is a success. Otherwise, you must keep on experimenting.

As so many of our personnel are from day to day becoming absorbed by the armed forces or the various defense activities, and materials and equipment only available in extreme emergency, it is a foregone conclusion that there will be little or no further work in ventilation until after the duration.

The experimental work above outlined has been accomplished by R. D. Bargman, research chemist in the Sewer Design Division, while general supervision of ventilation has been under E. G. Studley, supervisor, in the same division.

The three permanent stations have been designed in the Division of Sewer Design except certain structural features handled by the Bridge and Structural Division.

Work of this type is a function of the Department of Public Works, Bureau of Engineering, under Lloyd Aldrich, City Engineer.

Discussion:

MR. RAWN (Los Angeles): Do you find that type of ventilation for odor control more economical than chlorinating the sewage? Have you made any estimates of cost?

MR. SMITH: Yes, we have. However, I have no comparative estimates here with me.

DR. POMEROY (Pasadena): In case of the North Outfall, I think that ventilation is more economical because of the large flow of sewage, which would require a large amount of chlorine. Another point might be emphasized: It is necessary to distinguish different functions: corrosion control and odor control; corrosion requires drying out the sewer while odor control prevents the gases from causing a nuisance.

MR. KNOWLTON (Los Angeles): Some ten or twelve years ago the City of Los Angeles went to considerable expense for experiments in the use of chlorine.

MR. SMITH: Chlorine is more practical and satisfactory in smaller sewers than ventilation. I was thinking of ventilation for larger sewers.

MR. STEVENSON (Los Angeles): This problem of treating odorous gases with chemicals is more complicated than the average sewage works man

would believe. We have been working on this problem for a year and a half and, as Colonel Smith stated, we still do not have the answer. We picked probably the toughest situation in the United States when we picked that one spot. When conditions approach normal for an average sewer, we get marvelous results deodorizing the gases. But there are other sulfides besides hydrogen sulfide which are not so easily oxidized. If we were dealing only with straight hydrogen sulfide, it would be a little problem. The other gases require much greater concentrations of chemicals than the straight mathematical formula would indicate. For straight chlorine gas we can use about 200 p.p.m. of chlorine in a spray. This does not seem to do the work although it is many times more than the required chlorine for neutralizing the hydrogen sulfide present. Whereas, if we use a hypochlorite we can use thousands of parts per million of chlorine in the sprays without losing much chlorine. In these higher concentrations lies the answer to the problem. It is going to require the contact of thousands of p.p.m. of chlorine to completely oxidize all of the complicated organic sulfides.

DR. POMEROY: I would like to see someone try a new scheme. This idea of drawing air out of a sewer to prevent it from going up stacks and manhole covers probably has many applications. The quantity of air which should be exhausted is quite small and the expense may be high. What is the best natural deodorizing medium? The soil. You cover up some offal and it is deodorized in a remarkable way because of anerobic action. I would like to throw out this suggestion for anyone who would care to try it on a small sewer.

MR. BARGMAN (Los Angeles): We have been working at this problem about a year now and it isn't solved yet, but down at the Slauson Avenue ventilating plant we are running without complaints, which is something. In addition to hydrogen sulfide, there are indol, scadol and various mercapatans. One thing, there is not only the actual physical concentration of odors, but their persistency. Some war gases have the function of persisting longer than others; likewise, certain of these sewer odors seem to persist longer than others. Later on we will have more information to give out.

CAPTAIN LUEBBERS: (Camp San Luis Obispo): With reference to introducing gas to soil: why not run it to the underdrains of trickling filters?

DR. POMEROY: That is excellent, too—accomplishes the same thing.

CAPTAIN LUEBBERS: One thing you have to watch is the expense connected with blowing air through towers. We are interested in ventilating large quantities of air through towers and this may be too costly on account of resistance, unless the air can be blown through with comparatively low loss in head.

MR. WEST: I believe Mr. Smith is right. Ventilation is the secret—and most economical. I am speaking of the mechanical approach. I believe the time is just around the corner until we do something. I believe chemists are going to have to find the way out for us. I might say this regarding a tower: We had the idea of a cooling tower—of ærating pumping gas inside the tower and then let lime solution come down the steps, but that was not practical for large volumes of gas. I can see that the field is wide open and it is an inviting thing to "jump in and get your feet wet."

SAN BERNARDINO SEWAGE PLANT REVISIONS

By DAVID H. CURRIE*

When it was definitely decided to construct the San Bernardino Air Depot at San Bernardino, the Municipal Water Department, which by charter, operates the sewage treatment plant, was immediately contacted by the Los Angeles District Office of the U. S. Army Engineers in order to determine whether it would be more feasible for the Depot to construct their own Sewage Disposal Plant or to make a hook-up with the existing City Plant.

We were immediately contacted by the Water Department and made a preliminary study with estimates of cost of the enlargement of the existing disposal works. The length of the outfall line which the Army would have to build was approximately the same whether they constructed their own plant or not, so the only problem was the comparative cost of enlargement as against the cost of construction of their own plant. The Army requested that the cost submitted them by the Water Department should include the operation cost of disposing of their sewage for a period of 50 years.

Original estimates of personnel at the Depot as submitted us by the U. S. Engineer's Office were as follows:

DEPOT POPULATION

Classification	Number	Per Cent to Be Treated	Total Population Connected to Disposal Plant
Mobile Unit	5,000	100%	5,000
Depot Personnel	3,000	50%	1,500
Civilian Workers	6,000	40%	2,400
Total Population Connected to Disposal Plant			8,900

ADDITIONAL CITY POPULATION DETERMINED BY DEPOT PERSONNEL

Classification	Number	Per Cent to Be Treated	Total Population Connected to Disposal Plant
Depot Personnel Family (Wife and Child) . . .	6,000	100%	6,000
Civilian Workers	6,000	60%	3,600
Civilian Workers Family (Wife and 2 Children) .	18,000	100%	18,000
Total Additional City Population			27,600

*Engineer, Currie Engineering Company, San Bernardino, California.

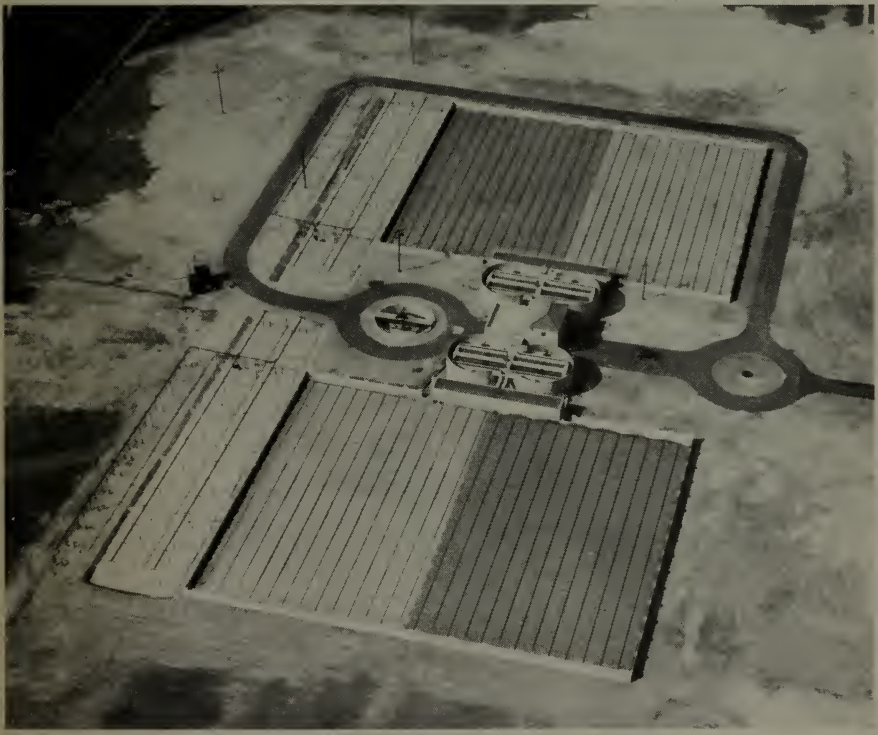
TOTAL POPULATION TO BE TREATED AT SAN BERNARDINO SEWAGE DISPOSAL PLANT

Depot Population	8,900
Additional City Population	27,600
Total	36,500

This figure has later been increased a very indefinite amount, but the civilian workers are now estimated at approximately 14,000.

The Army Engineers estimated that the construction of their own plant would cost them approximately $212,000. The operation based on $20 per million gallons for a period of 50 years, would run approximately three-fourths of a million dollars.

We estimated the cost of the enlargement approximately a year ago at $220,000. We felt that the actual increase in cost of operation would not be materially affected by the flow from the Depot, and as the proposed enlargement would provide considerable additional capacity for the city itself, we felt that a payment by the Army of $250,000 would be fair to both parties.



Air View of San Bernardino Sewage Treatment Plant

After dickering between this and a low figure of $135,000, it was finally agreed that the Government would pay the city $225,000 for the enlargement of the plant and the disposal of the sewage from the Depot for a period of 50 years.

It was July of this year before negotiations were completed and the cash deposited with the city. At that time bids were received for the construction of the plant. The low bid was $369,000. As the city had no funds available to care for the difference in cost, all bids were rejected, and it was decided to build the plant by day labor, the city purchasing the material.

We fully expect to enlarge the plant for a cost of $250,000 and construction is under way at the present time.

The existing plant consists of four Imhoff tanks, two trickling filters, a chlorine contact tank which acts as a small secondary tank, and sludge beds. As most of you have seen the plant, a detailed description is not necessary.

The flow chambers of the Imhoff tanks provided a capacity of 28,000 cu. ft. The digestion capacity equaled 120,000 cu. ft. There are two trickling filters, each 206.5′ by 259.5′ by 7′ providing 17.2 ac. ft. of filter rock.

The original design population was 60,000, and it was assumed, based on sewage gaugings at that time (1927) that the average flow per capita would equal 70 gallons, or an average daily flow of 4.2 m.g.d., and a maximum hourly rate of 7.0 m.g.d. On this basis, the flow chambers provide a detention period of 1.24 hours on the average flow, and 45 minutes on the maximum hourly rate. The Imhoff tanks provide a sludge capacity of 2 cu. ft. per capita.

The trickling filter beds were designed on a basis of 3,500 people per acre foot. This was based on the assumption of .17 lb. B.O.D. per person per day with 30% B.O.D. removal in Imhoff tanks, leaving .12 lb. B.O.D. per person applied to the filters. This equals 10 lbs. B.O.D. per thousand cu. ft. of rock for a population of 60,000.

The sludge beds were designed on a basis of .5 sq. ft. per capita.

Experiments and installations of both the "Aero-filter" and the "bio-filter" show that more continuous dosage at lower rates have increased the efficiency of trickling filters. We felt that an enlargement of a plant which would contemplate the increase in the size of the trickling filters, would lead only to the construction of an additional separate complete sewage treatment plant. Therefore, the most feasible and economical design would be one which would expand the capacity of the present plant to the limit of the capacity of the existing filter beds. This could be done in five ways, all of which were used in the new design.

First, pre-aeration of the sewage before sedimentation. Experiments and actual operation conditions at the Decatur plant led us to believe that pre-aeration for two hours, especially not too violent aeration, would not only reduce the B.O.D. of the sewage, but would act as a flocculator ahead of the primary clarifier.

Second, the best possible primary clarification with overflow rate of 800 gallons per sq. ft. per day.

Third, the reconstruction of the dosing chambers and the substitution of smaller nozzles on the filter beds so that the rate of application would be

materially decreased, and the time of application correspondingly increased. The existing trickling filters contain 17.2 ac. ft., or 752,000 cu. ft., of filter stone which can be conservatively loaded at 10 lbs. of B.O.D. per 1,000 cu. ft.

Assuming the sewage to contain .17 lb. B.O.D. per capita with 50% removed by aeration and primary sedimentation, the filters have a capacity sufficient to serve 88,500 people, which will be the design capacity for the proposed expansion.

Fourth, the construction of a secondary clarifier providing the same low overflow rates as the primary.

Fifth, the increase in the sludge capacity of the digestion tanks. This is to be done by removing the concrete in the tanks comprising the walls of the Imhoff flow chamber which will allow construction of two 2-stage digesters providing 2¼ cu. ft. for approximately 90,000 population. The alteration of the Imhoff tanks to digestion tanks will allow heating of the primary digesters which, of course, was impossible in the digestion compartments of the Imhoff tanks.

It was, of course, necessary in the design to provide for a stand-by primary clarifier, as the complete by-passing of the plant or the application of unsettled sewage to the trickling filters would be impractical. While the use of a secondary clarifier would not be absolutely necessary during such periods as might be required to repair the primary clarifier. Therefore, we have planned the secondary clarifier the same size and the water level at the same elevation as the primary so that it provides a stand-by unit. This has necessitated the pumping of the effluent of the trickling filter approximately 20 feet to the elevation of the secondary clarifier. This pumping, as well as the compressing of the air necessary in the aeration tanks, will be accomplished by the use of sewage gas in engines directly connected to the pumps and the blowers.

We believe we have increased the capacity of the present plant from a present actual capacity of 50,000 people to a future actual capacity of 90,000. We believe all of our standards of design are conservative and that the city will have a new plant which, while it will require more skilled operation, will be one of the outstanding plants in Southern California. Most certainly, considerable data can be acquired in the operation of the plant which will be valuable to all of us.

Professor Wilfred F. Langelier, professor of sanitary engineering, Harvey F. Ludwig were jointly awarded the Goodell prize of the American Water Works Association for 1942 for their paper and research entitled "Graphic Methods for Indicating the Mineral Character of Natural Waters." This paper, published in the March, 1942, issue of the A. W. W. A. Journal, is considered a significant contribution to water examination literature.

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Roy E. Ramseier is now Senior Sanitary Engineer, Pacific Division, U. S. Engineering Department, with headquarters at Salt Lake City. Roy is now in charge of all utilities and buildings of this division.

OPERATORS' SYMPOSIUM

September 20, 1942

SLUDGE GAS METERS

MR. BOWLUS: The first topic for discussion this evening is "Sludge Gas Meters."

MR. DAVEY (Bakersfield): We have sludge gas meters that work, so I can't help you out on troubles.

MR. BOWLUS: Can you tell us the make of meters used at the Bakersfield plant—the size, quantities of gas that goes through, etc.?

MR. DAVEY: I can't give you much information on that. We can get 26,000 cu. ft. of gas daily through our gas meter—and have done that for some time. We also have another of the same type, smaller, which we are using for the gas engine and run about 11,000 to 14,000 cu. ft. of gas through that meter every day. We have very little trouble with these meters. One little arm on top broke, but it was not due to sludge gas. On those meters there is an adjustable arm that works the valve mechanism. A hole is left for making it longer or shorter. I believe it is made by the L. A. Meter Co. and the parts would have to come from there.

MR. BOWLUS: Have your meters been in service six months?

MR. DAVEY: No, about three years—but there was no gas for about six months. We do have to drain our waste gas meter now and then.

QUESTION: Do you have a water trap ahead?

MR. DAVEY: Yes, but we don't get all the water out.

MR. WOODWARD (Laguna Beach): We have the regulation gas meter used by the Southern California Gas Co. It has been in service seven years. When we first installed it there was no condenser ahead—just a water trap. I installed a condenser on the meter. The meter has to be overhauled once a year regularly, otherwise it does not function.

DR. POMEROY (Pasadena): What sort of condenser did you put in?

MR. WOODWARD: I made it myself: using a long cylinder with a steel pipe in the center which runs down to within about four inches of the bottom of the cylinder and then rises in the space between the steel pipe and the cylinder.

MR. MAY (Palo Alto Plant, Palo Alto): We have our own gas meters at Palo Alto. Those were a lot of old gas box meters in use at our plant for six or seven years. The leather becomes disintegrated and we do not replace them—just throw them away. I think, however, we should install some sort of standard type gas meter, if there is such a one, and all plants measure gas at some standard pressure and temperature so we can have a way of comparing plants to determine the rate of gas production and use. Ours seems to be as high, if not higher, than the rate of many other plants reporting, but I do not know if our conditions are the same as at other plants. If there was some standard setup we possibly could compare our digester gas production a little better.

MR. BOWLUS: That is worthy of consideration.

MR. RAWN: Two or three years is not a fair criterion for the use of a meter. You have to use them longer than that. It occurs to me the best way to measure gas would be to measure it on some sort of device showing the head loss in a tube. If one had a tube of known characteristics, a straight piece of galvanized pipe 200 ft. long and took the pressure at either end, he could quickly determine how much gas flows through. If you cannot get a meter that works and want to learn what gas is developing, with something that does not have this constant recording device in it, as do the various types of intricate mechanism in an ordinary gas meter, one can be developed very simply and cheaply.

MR. BOWLUS: Something like a Venturi meter?

MR. RAWN: Yes, take the head loss in your pipe line and, knowing its diameter and other characteristics, it will serve the same purpose as a Venturi meter.

CAPTAIN LUEBBERS (San Luis Obispo): The use of galvanized pipe might be unsatisfactory if there is any sulfur in your gas. This corrodes the zinc in the galvanizing, causing an electrolytic action. I might suggest the so-called Roto-Meter. The tube is glass and the floats are stainless steel. Observations can be made through the glass wall. A straight Venturi meter of stainless steel would be satisfactory.

MR. RAWN: Ordinary vitrified clay pipe would be satisfactory too.

DR. POMEROY (Pasadena): With regard to Mr. May's suggestion: it is true gas flows should be standardized as to pressure, say 30 in. of mercury, and temperature, 20° Centigrade.

MR. BOWLUS: Is that given in Standard Methods?

DR. POMEROY: That is standard gas technology; 20° Centigrade and 30 inches of mercury.

SLUDGE HEATING COILS

MR. BUSH (Camp Cook): The Camp Cook plant has been in operation only a matter of six or seven months. We have experienced one thing, however: the digester is producing abundant gas. We have been unable to raise the temperature in the sludge. We should get a higher temperature than we do, 75° in the digester using circulating coils. We have not taken the coils out to inspect them, but think probably they are caked considerably with dried sludge. Even with high temperature through the coils, there is comparatively little heat transfer.

MR. RAWN: Do you take the temperature as it goes in?

MR. BUSH: Yes, it is 180°.

MR. MAY: Since it is only seven months old, the coils should not be badly caked.

QUESTION: Are you able to take the coils out for inspection?

MR. BUSH: Yes, it would be possible. The coils are not located around the periphery, but extend through the center of the dome. They can be easily disconnected and lifted out through the top.

CAPTAIN LUEBBERS (San Luis Obispo): What indication do you have of the rate of circulation through the pipe?

MR. BUSH: I am sure we are getting a flow through the coils because we have hose bibbs that can be opened at different places.

CAPTAIN LUEBBERS: There may be a high point that stops the flow completely because of an air lock.

MR. RAWN: This water comes out at 179° but nothing is said about the rate of flow.

MR. BUSH: It is a complete circulating system and apparently we are getting circulation.

MR. RAMSEIER (U.S.E.D. San Francisco): Are there two pipes coming to the top?

MR. BUSH: There are four loops in the two digesters.

MR. RAMSEIER: I have seen a number of those coils with four loops. They are usually set up so you have to pull the whole works out. It is quite a heavy mass of metal. Each coil is 20 feet long, so it is almost a major construction job to get the coils out.

QUESTION: Can you give us a rough estimate of the lineal feet in the coils?

MR. BUSH: There would be about 120 to 150 ft. of 1¼″ pipe in each digester.

MR. DAVEY: We could not get our sludge temperature much above 80°. We understood we should not raise it above 130° or caking would result. We put 100 ft. more coil in, and now keep our digester at 92°.

QUESTION: At what temperature do you inject the water into that?

MR. DAVEY: 130°—and it returns at 112°. We use 2-inch pipes. We found the coils badly caked when we had our digester shut down. There is a little worry now that the coils won't last much longer because they are badly corroded and are made of thin pipes.

MR. BOWLUS: Can you give us some idea of the total length of sludge pipe?

MR. DAVEY: I would say there was 120 ft. of coil—they go to the top of the tank, but the sludge does not. The coils contained 120 ft. to begin with, but now we have added 120 ft. more, besides one joint of pipe cut up in four lengths as a header.

MR. BOWLUS: This makes a total of 240 lin. ft. of 2-in. pipe—and what is your capacity?

MR. DAVEY: I don't know, but the digester is 45 ft. in diameter.

MR. RAWN: Mr. Davey stated 92°. Is there any change between summer and winter?

MR. DAVEY: This new pipe has only been in since April.

MR. RAWN: Then you might have some trouble this winter when the sludge temperature falls to about 75°.

MR. WOODWARD: I might relate we had lots of difficulty the first two years. We had five coils starting from about three feet apart. We couldn't get any heat regulation, with poor digestion, and plenty of trouble. We tore them out and now have vertical coils, placed at four points, evenly spaced from the center and outside wall. Being quite a ways from the wall, we figured we could get more even temperature and we have not had any trouble heating the digesters. We can control the pH and hold the temperature around 85° or 90° or we can run it up higher if we wish. We might find we would have to increase the length of the coils if the plant were

increased in capacity. We used Ever-dur Pipe, 1½″, four feet from the bottom, and circulate water through with a small pipe at a rate, I believe, of about 10 g.p.m. The boiler temperature is about 150° and the return water is about 115°. We try to maintain a sludge 85° to 90° summer and winter and do not have any difficulty. There are 4 coils of 88 ft. All of the rest of the pipes are jacketed to hold all the heat possible. We have hardly any sulfides, and the pH stays practically at 7.2 most of the time.

MR. PALMER: I think probably the question in figuring out the size of these coils, is not the gross sludge capacity, but what you are putting in every day. The question of the length of pipe really depends upon the area of the outside of the pipe as well as the length. Heat must be dissipated from the inside to the outside at the rate of so many B.T.U. per square inch for each degree of difference in temperature. It does not make very much difference how fast you pump the water through. You must supply so much B.T.U. to the sludge—if you pump very fast it will come back at nearly the same temperature, but if you pump slowly there will be a big difference. About all the heat needed is for the sludge you have pumped each day, plus a little for the heat lost during the night.

MR. DAVEY: We pump about 9,000 gallons per day at the Bakersfield plant.

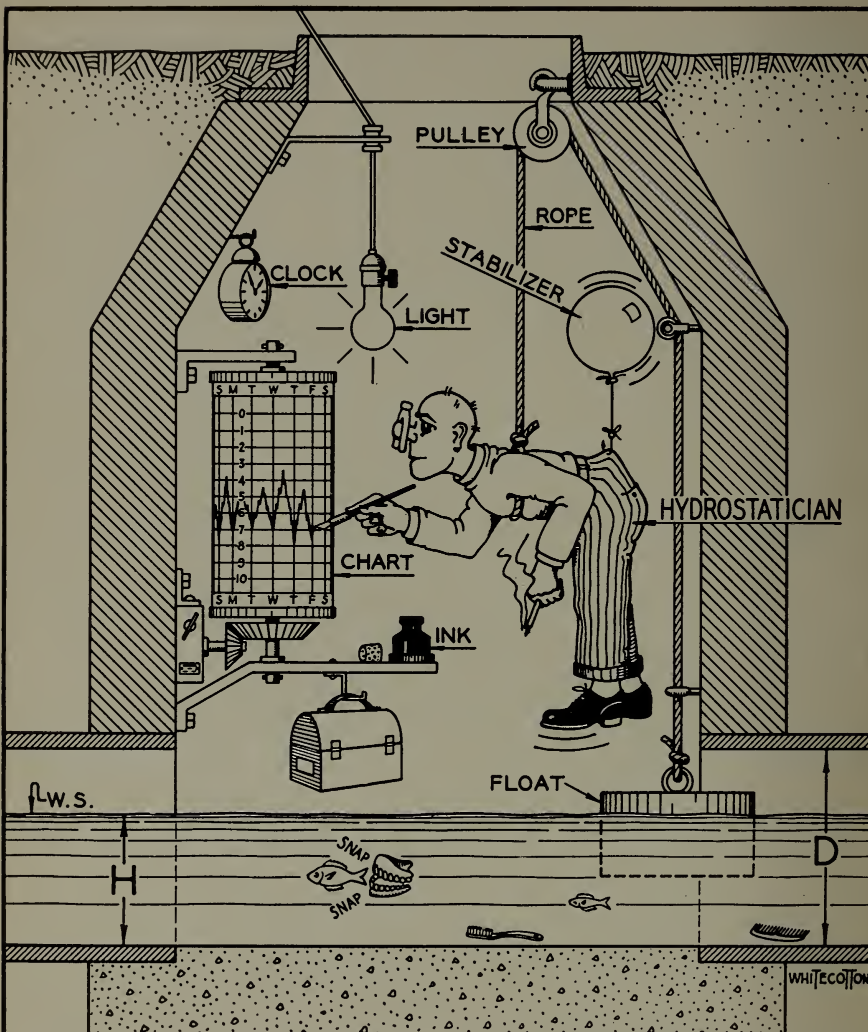
MR. BOWLUS: Mr. Bush, how many gallons per day do you pump at Camp Cook?

MR. BUSH: I think now about 9,000 or 10,000 g.p.d. However, the solid content is not too heavy.

MR. RAWN: About seven years ago we cleaned our sludge digestion tanks at the Joint Disposal Plant, and we cleaned the coils at the same time. They were cast iron pipe, 2-inch, I believe. At the time we cleaned these coils they had been in service I'll say about four years, incrusted with scale from ¼ to ½ in. thick. At the time we cleaned them, we were putting water into the system pretty close to the boiling point. There is another disadvantage: unless one provides sludge heating capacity for the winter sludge condition, he is likely to find himself in difficulty in the spring. The thing has a lot of repercussions. Mr. Bush of Camp Cook will have trouble next spring, as the sewage cools off this winter and he gets it up to only 60°, then in the spring when it gets up to 85° it will flow all over the camp. Sludge coils will give you a lot of difficulty just that way. Most any type of coil will corrode rapidly.

DR. POMEROY: This data which has been presented, in some instances gives information from which we might calculate the rate of transfer of heat. We would need to refine that data, but I think it would be worth while for any operator to figure that out so it may be available as a basis for design. Figure out how many B.T.U. are actually transferred, the amount of heat transferred being proportional to the difference in temperature and the area of coils. If you know the temperature of the water going in and coming out, and the rate of flow of water, this may be figured. I do not recall off-hand, but believe with dirty coils that you can count on a transfer of about 10 B.T.U. per sq. ft. per day.

MR. WOODWARD: If anybody would like to see the plant at Laguna,



Trials and Tribulations of a Sewer Zanjero

they are welcome to see the coils. These coils can be lifted from the top. I take temperature from the sludge itself.

MR. BOWLUS: Dr. Pomeroy is chairman of our Design Committee, and I think it would be a fine thing if the operators would follow his suggestion and turn the data over to him.

DIGESTER SCUM

MR. MAY: All I can say is that we have had a lot of scum. It is gain-

ing on us every year. I wish somebody could figure out an easy way to get rid of it.

A GENTLEMAN: You can foam it out.

MR. RAWN: Foaming isn't a half-bad idea when you get a lot of scum on your tanks.

MR. DAVEY: We run it out of the tanks into our clarifiers.

MR. RAWN: If the tank is foaming, take it out to one of the beds.

MR. MAY: The old digester won't foam when you want it to.

MR. RAWN: You go down to Camp Cook this next spring. You'll see plenty of it; foaming all over the place!

PUMP AND MOTOR STANDARDS

MR. PALMER: After the meeting in Bakersfield, the Directors appointed a committee to draw up a set of standards for sewage pumps, motors and controls. This committee consisted of: F. H. Batty, Joseph Corrao, C. M. Hoskinson, D. R. Kennedy, and myself, as chairman. Mr. Corrao is in the Navy but the rest of us have had some correspondence with pump designers, a meeting has been held with some pump and motor engineers, and we have drawn up a set of specifications for sewage pumping units. Any pump purchased on these specifications will be used by you operators and we feel that you should be permitted to suggest any changes.

These specifications cover the material and design of pumps and must be accompanied by a data sheet showing the head and capacity of the pump, horizontal or vertical shaft desired, direction of rotation and any other data required. Since it would be impossible to draw up a set of standards that would suit everyone, provision is made so that any item in the specifications can be modified by calling for the modification on the data sheet and this modification will automatically cancel and supersede the standards for that item.

CALIFORNIA SEWAGE WORKS ASSOCIATION STANDARD SPECIFICATIONS FOR SEWAGE PUMPS, MOTORS AND CONTROLS No. SP-1

These specifications cover the design and materials used in the manufacture of pumping units, for raw sewage, consisting of a centrifgual pump connected to a motor and provided with a suitable motor control. They are to be accompanied by a data sheet showing the quantity to be pumped; the total dynamic head at mean water level in the wet well; type of pump wanted (horizontal or vertical shaft), direction of rotation; any special setting or limiting dimensions; any special feature not mentioned in these specifications; and any modification to these specifications.

In case of a discrepancy between these specifications and the data sheet the data sheet shall prevail.

Pump Size—For total dynamic heads of 50 feet or less the pump should be of such size that the velocity of water in the suction nozzle of the impeller does not exceed 14 feet per sec., corresponding to the following table:

Diameter of suction nozzle (inches)—	3	4	5	6	8	10	12
G. P. M.	325	550	850	1250	2200	3500	5000

For heads in excess of 50 feet these quantities may be multiplied by $\sqrt{\frac{H}{50}}$ where H= the total dynamic head, or by the following factors:

Total dynamic head (feet) —	60	70	80	90	100
Factor	1.1	1.2	1.25	1.35	1.4

Base and Suction Elbow—Horizontal pumps and motors shall be mounted on a common cast iron base of sufficient strength to maintain the alignment under all conditions. Vertical pumps shall be mounted on a suitable base resting on the floor of the pump room unless the data sheet shall call for mounting on concrete pedestals.

Vertical pumps shall include a long radius reducing elbow on the suction nozzle of the pump, the reduction amounting to a difference of one pipe size. If a reducing elbow cannot be supplied the bidder must so state in his bid. This elbow shall be provided with a suitable hand hole of ample size and so placed as to facilitate cleaning the suction eye of the impeller. The cover shall be held by two stud bolts and be streamlined on the inside to minimize resistance and prevent catching rags and solids.

Pump Casing—The pump casing shall be of close grained gray cast iron, or iron alloy approved by the purchaser; machined on all contact faces and with smooth water passages. Tapped holes shall be provided for venting the air, draining the case and attaching gauges to both the suction and discharge nozzles for testing in accordance with the Test Code of the Hydraulic Institute. Provision shall also be made for attaching a drain pipe for leakage from the stuffing box.

Vertical pumps shall be so made that the shaft and impeller assembly can be removed from the volute without disturbing the motor or pipe connections.

Impeller—The impeller shall be of the 2-port enclosed type, made of cast iron of not less than 30,000 pounds per square inch tensile strength, balanced statically and dynamically, with smooth, well rounded water passages; and shall be rigidly keyed to the shaft on a long taper, and held in position by a streamlined locknut.

The size of solids which the impeller shall be able to pass shall depend upon the diameter of the pump suction, as shown in the following table:

Diameter of pump suction (inches)	3	4	5	6	8	10
Diameter of ball to be passed (inches)	2	2½	3	3½	4	4

Wearing Rings—Wearing rings or adapter rings shall be provided to prevent rags and solids accumulating behind the impeller. These rings shall be of such material that they can be easily removed after several years' use. If the material in the rings is not the same as the impeller and/or the case they shall be attached with tight, clean threads and dowels to make good electrical contact. The clearance shall not exceed .005 inch on pumps of 8-inch or smaller, suction, increasing to .012 inch on 18-inch pumps, and .015 inch for 36-inch pumps.

Double Suction Pumps—Large pumps may be double suction type, each side of the impeller having 2-port channels capable of passing the same size solids as single suction impellers with the same size suction nozzle.

The water passages of the suction Y shall be so rounded that no stringy material will be caught. The bearing below the impeller shall be a sleeve bearing with oil or grease lubrication.

Bearings— The pump shall be equipped with a combined radial and thrust bearing near the end of the shaft opposite to the impeller, and a radial bearing between the thrust bearing and the impeller. The over-hang from the radial bearing to the impeller shall not exceed the distance between the bearings, measured center to center in each case.

Sleeve bearings for pump and motor shall be of such a size as to limit the bearing pressure to 100 pounds per square inch, and shall be provided with grooves for properly distributing the lubricant to all parts. Horizontal pumps with sleeve bearings and oil lubrication shall have oil rings of a suitable corrosion-proof material.

Ball bearings shall be of standard make and size so they can be easily and quickly replaced and stressed to less than the manufacturer's specifications.

Grease lubrication systems shall make provision to force out old grease, and limit the pressure. All housings shall be dust and moisture proof, on both pump and motors, except the bottom bearing on double suction pumps.

Shaft— The shaft shall be of high-grade steel, heat treated, turned, ground and polished, and of sufficient diameter and strength to prevent vibration when the pump is in operation. A renewable shaft sleeve of 18-8 stainless steel, chrome nickel, Meehanite iron or other tough, corrosion-resistant material, with a Brinell hardness factor of 400 or more, shall be rigidly attached to the shaft in the stuffing box.

Stuffing-Box—The stuffing box shall be sufficiently deep to hold at least five (5) rings of packing, and shall be provided with a water seal and split gland. The pump shall be packed with metallic packing.

Coupling— A horizontal pump shall be connected to the motor by a flexible coupling. A vertical pump shall be connected to the motor by a shaft containing two universal joints permitting a deflection of 3 degrees each, with a longitudinal extension of ¾ inch, and supported by bearings spaced not more than 7 feet, except that where the total length of the shaft is not more than 7 feet no bearing will be necessary. The shaft shall be dynamically balanced.

Motor— The motor shall have the following electrical characteristics: 3-phase, 60-cycle, 440 volts, 40°C.

Normal torque low starting current for line starting within the horsepower range permitted by the power company. Where reduced voltage starting is required, normal starting current squirrel cage motors may be used, unless another type is called for. The horsepower shall be ample for all loads within the pumping range, leaving a safety margin of 5% less than the ultimate load the motor will carry, to allow for overloading due to excess tightening of the packing gland, or other causes.

Wound rotor motors shall be adjustable, varying speed type capable of a speed reduction of 50%. Power will vary approximately as the cube of the speed, and resistance grids shall be figured on this basis, unless more detailed data is furnished.

Synchronous motors shall be 80% power factor machines with amortisseur windings, and with direct connected exciters.

Squirrel cage induction motors shall be supplied unless another type is called for on the data sheet.

All types shall have coils wound with enameled wire which after forming has been coated with several layers of baked enamel baked to form a solid mass, with extra insulation in the slots.

The rotor winding of the squirrel cage motor shall be of cast copper or aluminum with ventilating fins cast integrally. The shaft and rotor shall be balanced statically and dynamically.

The frame shall be of standard dimensions, rigid in construction, with sleeve or ball bearings, and lubrication systems similar to those of the pump.

Motors shall be General Electric, Westinghouse, or other make approved by the purchaser.

MOTOR CONTROL

Squirrel Cage Motors— The control shall consist of the combined fused disconnecting switch and magnetic, non-reversing, across-the-line type starter, with low voltage and thermal overload protection. The overload protection shall be operated by a suitable bi-metallic strip and shall be hand reset. A start-stop push button shall be included. The whole shall be inclosed in a standard sheet metal case, unless otherwise called for on the data sheet.

When air-circuit breakers again become available, or the priority is sufficient they shall be used in place of the fuses.

Fuses (or circuit breakers) and heating coils shall be rated liberally to avoid unnecessary outage.

Where line-starting is not possible, a reduced-voltage starter shall be substituted with similar protection.

Wound Rotor Motors— The primary control shall be the same as for squirrel cage motors. The speed control shall be of the automatic or manual type as called for on the data sheet with not less than 7 points. The grids shall be of the adjustable, varying speed fan duty type, enclosed in a suitable box.

Synchronous Motors—The starter will be similar to the starter for the squirrel cage motor, except that overload relief will be operated by a time limit relay. Pull-out protection shall be provided to stop the motor on loss of synchronism.

Performance Curves— The bidder shall submit with his bid a performance curve for the pump showing the quantity, efficiency and brake horsepower at various heads. Data regarding the motor shall include guaranteed efficiency and power factor at 125%, 100%, 75% and 50% load.

Complete descriptive matter pertaining to the equipment offered shall accompany the bid.

DISCUSSION

PUMP SIZE

MR. PALMER: We took the matter of size up with some of the pump men and it was suggested that the best size would be such, that the velocity

in the eye of the impeller should not exceed 12 feet per second for heads of 50 feet or less, but could be larger for higher heads.

MR. ALLEN: I like the low-speed pumps. Unless you specify the size of the pump is there a way to limit the speed?

MR. PALMER: I brought that up to Mr. Cook of the Fairbanks-Morse Company but he was reluctant to give a figure. Mr. Hollander of the Byron Jackson Company recommends limiting the size of the pump.

TWO-PORT IMPELLERS

MR. MAY: Can you make a pump in such a way that you don't have to take the rags out by hand?

MR. PALMER: That is what we would like to do and it has been found that the two-port design comes nearer to doing this than any other. One pump company some years ago tried a single port impeller but it was not practical and has been abandoned. A three-port impeller is now being pushed by one company, but theoretically it should be a rag catcher, and I believe it is proving to be one, so the committee does not recommend it.

MR. ALLEN: What about the size of solids to be handled?

MR. PALMER: When sewage pumps were first made the openings in the impeller were made about one size smaller than the suction. This was too large and caused excessive cavitation, and was accompanied by excessive wear and loss of efficiency. It also required a much heavier impeller, adding to the size of the shaft and bearings. This rule still applies to pumps with suction less than four inches in diameter, but for four inches and larger, the opening can be made somewhat less, especially if a bar screen is placed ahead of the pump. After careful consideration, the committee decided that four inches was the largest size of solid to handle in even the largest pump.

MR. RAWN: Suppose you have a four-inch and a six-inch pump in the same plant. What is going to control the size of solids then?

MR. PALMER: Theoretically, the four-inch pump would control since the bar screen would be the same, but if the standard six-inch pump passed a three and a half inch solid, asking for a special impeller to limit this to two and a half inches would require special patterns which would increase the cost without sufficient benefit. If the designer feels that the extra expense would be justified, he can write it in on the data sheet.

WEARING RINGS

MR. PALMER: What is your experience with adapter rings on the outer edge of the impeller?

MR. HOSKINSON: I can only say that for the size of pumps we use we have bronze rings with bronze impeller. If bronze rings are used on a cast iron impeller electrolytic action will destroy the connection unless they are well banded. I would like to leave the rings off on a small size pump.

MR. ALLEN: If you leave out the rings wouldn't you have to periodically build up your impeller?

MR. PALMER: Most of the wear would come on the lip of the vanes, whereas the rings merely close the space between the sides of the impeller and the pump casing so I doubt if they would change that condition.

A GENTLEMAN: We have some small pumps and we have to pull the impeller out every two weeks to take out about a teacupful of lint and hair. We have variable speed pumps and the binding is mostly near the suction.

MR. PALMER: The lint can pass around the outer edge of the impeller and lodge behind near the suction.

MR. HOSKINSON: Our worst trouble is a piece of rubber tubing. It can stop a pump dead.

IMPELLERS

MR. DAVEY: Why would you recommend a closed impeller?

MR. PALMER: Messrs. Batty, Hoskinson and Kennedy, of the committee, concur with me in the advisability of using closed impellers.

MR. ALLEN: The open impeller will clog more than the closed one.

MR. DAVEY: Our experience is that the open impeller pumps never clogged and the closed ones have, so that I would prefer the open type; but I am not an "old timer" at this.

MR. WOODWARD: We never have any trouble from clogging unless the runner gets worn from sand and gets too much clearance along the outside edge.

MR. PALMER: If you want the open impeller, just a few words on the data sheet will get them. I remember years ago before I went to work for the Sanitation Districts, we used the elevation of the water in a sand trap to measure the flow. There was a sluice gate in front of the outlet and the frame and valve stem used to catch floating moss which clogged the outlet and affected the flow measurements. A board was placed across the entire frame which compelled the moss to float to one side or the other and no more was caught. This was similar to the action of a two-port impeller and explains why this type is so superior to others.

Fairbanks-Morse wanted me to O.K. a three-port impeller, but I said "nothing stirring," because they are too apt to catch rags. Tomorrow you will see some three-bladed mixflo pumps which have to be back-washed every shift to clear the rags.

MR. HOSKINSON: Do you have any trouble in balancing when the rags catch?

MR. PALMER: I haven't heard of any. Once our superintendent complained that his pump was clogged but he couldn't afford the time to shut down to clean it. A calculation showed that he could afford to shut down for 15 minutes.

MR. RAWN: Won't the rags collect on the water face of the impeller? To wash those pumps they simply stop the pump and let it back wash. There is no delay now in washing.

MR. ALLEN: We have three identical pumps, two bind and one has never given us a bit of trouble, so I don't know what causes it.

DOUBLE SUCTION PUMPS

A GENTLEMAN: I know of one installation where two pumps had their suction only 15 inches apart and a pair of overalls got caught with a leg in each.

SHAFT

MR. ALLEN: Does the specification call for Monel or other hard metal shaft sleeve?

MR. PALMER: Stainless steel or nickel alloy. The Kimball-Krogh Company thought a tough material was better than a hard one. We tried once, putting in very hard, case-hardened material. After about nine months it was all worn out. Meehanite has worked very nicely.

MR. ALLEN: We use Meehanite too and like it.

MR. RAMSEIER: How about that water seal?

MR. PALMER: You can put in the water seal if you want to.

MR. ALLEN: How about using grease instead of water? Water seals are fine, but conducive to trouble.

COUPLING

MR. RAMSEIER: I was wondering if it has proved advisable sometimes for the elimination of pounding to place a flexible coupling directly between the pump and motor?

MR. PALMER: Yes, there is no objection to that. We have two cases where he had long shafts which give trouble so we lowered the motor down near the pump using the Watson-Spicer Universal coupling shaft. That has done away with practically all of the trouble. These shafts permit of a 3° misalignment. If there is a slight misalignment the pump will still work and just wear out your shaft a little.

MOTORS

MR. PALMER: The matter of voltage was put up to the General Electric Company. They said they thought that a majority of the plants are using 440 volts. This results in a saving of copper and in the cost of the control, as both must be heavier for 220 volts.

MOTOR CONTROL

MR. HOSKINSON: We found in specifying synchronous motors that it was difficult to compromise between the minimum starting current required by the manufacturer and the maximum that the power company would allow. However, the motor manufacturer finally got under that 500-amp. maximum. That is the starting equipment is something to consider.

MR. BOWLUS: This whole question of pump specifications seems to be one that might come before our Sewage Works Association; and perhaps we should take some action in the near future toward a standard specification. That is what we had in mind in getting this discussion started. Some of the cities and other organizations do not have the proper engineering forces to assist in the design and purchase of pumps and motors. Therefore, we thought the Sewage Works Association, after sufficient investigation, might later adopt standard specifications if we could make out a set which would be suitable in most cases or could be corrected in a minor way.

We would like to get an expression from some of the men in the smaller plants. What do you think about these standard specifications?

MR. RAWN: I think your point is well taken. The average engineer

hasn't the force behind him, and if something of this sort were available it certainly should be a tremendous advantage. They would all welcome it.

MR. BOWLUS: You can see from Mr. Palmer's remarks, that the committee has already taken into consideration the pump manufacturers in this area.

MR. ALLEN: I think if you can get out a standard specification, it will eliminate lots of "chiseling."

MR. PALMER: The pump manufacturers have told me they would like very much to cooperate with us in every way and cut out some of the inferior pumps sold on competitive prices.

MR. DAVEY: At Bakersfield they had some kind of idea that they wanted a certain kind of pump and specified grease-bearing instead of oil-bearing. Our Kimball-Krogh pumps are good, but messed up by putting oil in a grease-bearing pump. It would have been better to have left them as they were built.

Program—16th Annual Meeting—A War Conference

(Concluded from Page 4)

7:00 P.M.—Annual Dinner. Address by Dr. W. L. Halverson, Director, State of California, Department of Public Health.
Subject: Tropical Diseases and War.

Sunday, June 13, 1943

7:00 A.M.—Operators' Breakfast. — Each one present may attempt to qualify as Toastmaster.

9:00 A.M.—**How to Keep the Plant Running in War Time**—
President Carl M. Hoskinson, presiding.

1. Emergency Land Disposal and Lagooning of Sewage, by William J. O'Connell and Harold F. Gray.

Discussion: Wm. T. Knowlton, Chester G. Gillespie.

2. Emergency Protection and Mutual Aid for Sewerage Works.

Discussion: Professor Charles Gilman Hyde, Harold F. Gray, E. A. Reinke, Capt. Wm. T. Ingram, R. F. Goudey.

3. Post War Planning for Sewage Works, by A. M. Rawn.

2:00 P.M.—1. Priorities and Replacement of Sewage Works Equipment. Discussion: C. R. Compton, A. L. Frick,Jr., (Wallace & Tiernan Sales Corp.), E. B. Besselivre and A. M. Kivari (The Dorr Co., Inc.), Fred E. Miick (Link-Belt Co.).

2. Manpower and Operation of Sewerage Works. Discussion: Ray Ramseier, B. D. Phelps, Victor Sauer, H. P. Cortelyou, J. C. Albers.

4:00 P.M.—Business Meeting.
Reports of Committees.
Election of Officers.

5:00 P.M.—Adjournment.

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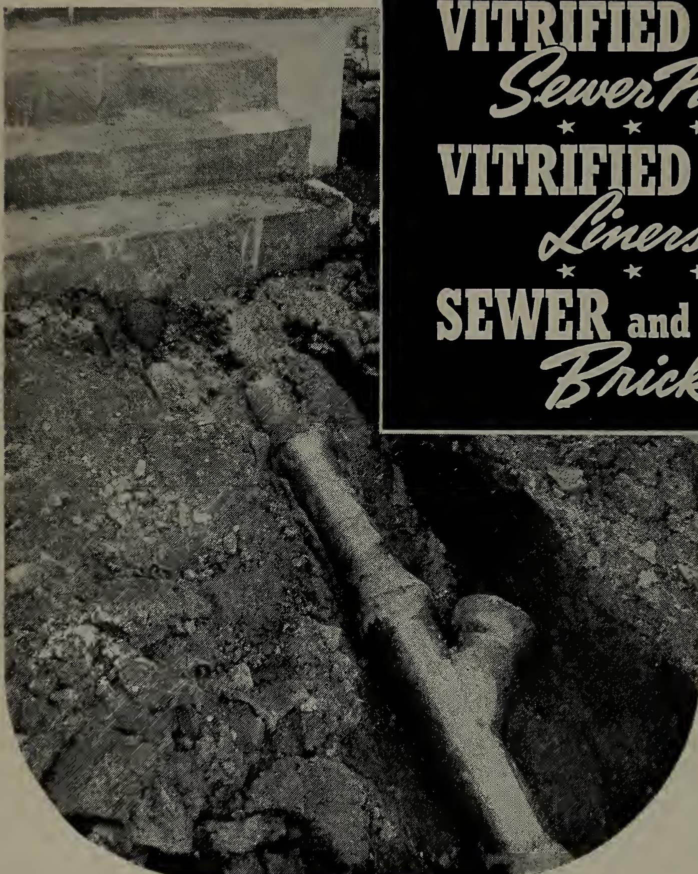

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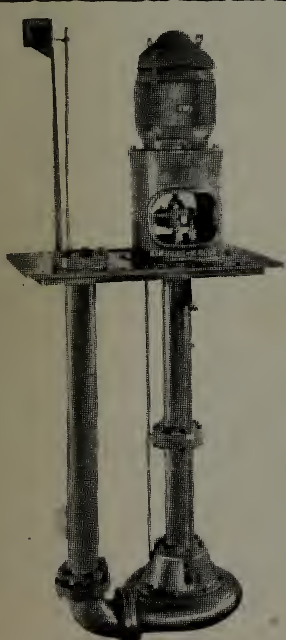

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